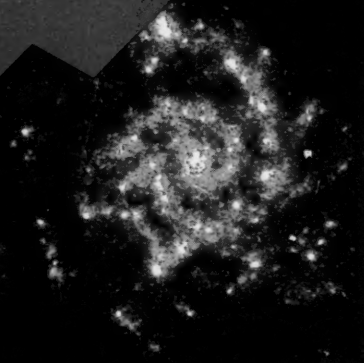
Scientific and Technical Aerospace Reports

STAR



An Abstract Journal

Volume 30, Number 5
March 8, 1992
N92-13926 to N92-14965

Scientific and Technical Aerospace Reports

Scientific and Technical Aerospace Reports (STAR) is an abstract journal that provides comprehensive coverage of worldwide aerospace-related reports. It is a major product of the International Aerospace Database managed by the NASA Scientific and Technical Information (STI) Program. The coverage includes reports on aeronautics, space, and supporting disciplines. *STAR* lists current, publicly available reports entered into the NASA STI Database during the 2-week period preceding publication. A typical citation and abstract appear on page viii. They explain how to read the items that are announced in this journal.

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***Scientific and Technical Aerospace Reports* (*STAR*)** is an abstract journal that provides comprehensive coverage of worldwide aerospace-related reports. It is a major product of the International Aerospace Database managed by the NASA Scientific and Technical Information (STI) Program. The coverage includes reports on aeronautics, space, and supporting disciplines. *STAR* lists current, publicly available reports entered into the NASA STI Database during the 2-week period preceding publication. A typical citation and abstract appear on page viii. They explain how to read the items that are announced in this journal.

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US ISSN 0036-8741

Volume 30 Number 5 / March 8, 1992

TABLE OF CONTENTS

AERONAUTICS For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) **691**

02 AERODYNAMICS **702**
Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also *34 Fluid Mechanics and Heat Transfer.*

03 AIR TRANSPORTATION AND SAFETY **705**
Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION **706**
Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE **712**
Includes aircraft simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION **714**
Includes cockpit and cabin display devices; and flight instruments. For related information see also *19 Space craft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER **716**
Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL **718**
Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) **719**
Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS For related information see also *Aeronautics.*

12 ASTRONAUTICS (GENERAL) **719**
For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS **719**
Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) ..... **N.A.**
Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES ..... **N.A.**
Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION **726**
Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING . **N.A.**
Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N.A.—no abstracts were assigned to this category for this issue.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE **726**
Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION ..... **N.A.**
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER **728**
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

23 CHEMISTRY AND MATERIALS (GENERAL) **729**

24 COMPOSITE MATERIALS **730**
Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY **732**
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS **735**
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS **740**
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS **742**
Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING **743**
Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology.*

ENGINEERING For related information see also *Physics.*

31 ENGINEERING (GENERAL) **743**
Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR **745**
Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING **757**
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER **761**
Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY **768**
Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS **769**
Includes parametric amplifiers. For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING **770**
Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY **777**
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS **777**
Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) ..... **N.A.**

43 EARTH RESOURCES AND REMOTE SENSING **787**
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **788**
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **795**
Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **798**
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **809**
Includes weather forecasting and modification.

48 OCEANOGRAPHY **811**
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

51 LIFE SCIENCES (GENERAL) **811**

52 AEROSPACE MEDICINE **812**
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **813**
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **813**
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY ..... **N.A.**
Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) **815**

60 COMPUTER OPERATIONS AND HARDWARE **815**
Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **816**
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **824**
Includes computer networks and special application computer systems.

63 CYBERNETICS **826**
Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **831**
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **837**
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **840**
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **840**
Includes topology and number theory.

PHYSICS For related information see also *Engineering.*

70 PHYSICS (GENERAL) **840**
For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS **841**
Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS **845**
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS **849**
Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

74 OPTICS **850**
Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS **851**
Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS **854**
Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS **857**
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

80 SOCIAL SCIENCES (GENERAL) **859**
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT ..... **N.A.**
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE **859**
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS ..... **N.A.**
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY **863**
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION **865**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) ..... **N.A.**

89 ASTRONOMY **865**
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS **866**
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION **868**
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS **869**
Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

93 SPACE RADIATION **871**
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL **871**

SUBJECT INDEX **I-1**

PERSONAL AUTHOR INDEX **I-69**

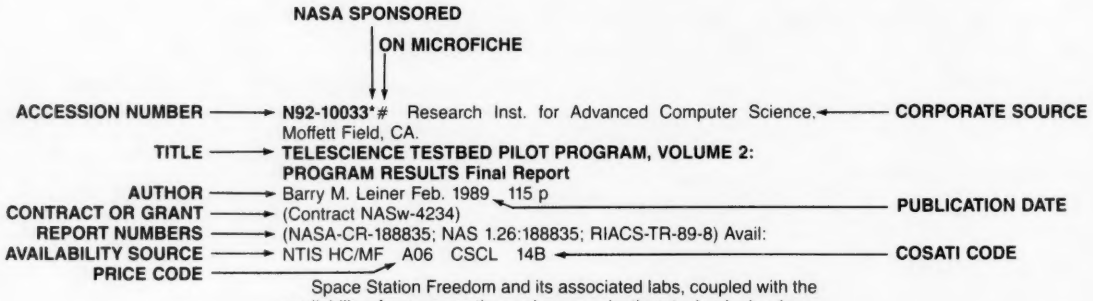
CORPORATE SOURCE INDEX **I-79**

CONTRACT NUMBER INDEX **I-91**

REPORT/ACCESSION NUMBER INDEX **I-93**

APPENDIX **A-1**

TYPICAL CITATION AND ABSTRACT



Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.

Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-13926# Executive Resource Associates, Inc., Arlington, VA.
GENERAL AVIATION ACTIVITY AND AVIONICS SURVEY, CALENDAR YEAR 1989 Annual Report
1989 469 p Prepared in cooperation with Adsystech, Inc., Silver Spring, MD
(PB91-179234; FAA-AMS-420) Avail: NTIS HC/MF A20 CSCL 01B

The results of the Annual General Aviation Activity and Avionics Survey are presented. The survey is conducted by the FAA to obtain information on the activity and avionics of the United States registered general aviation aircraft fleet. Breakdowns of active aircraft, annual flight hours, average flight hours, and other statistics by manufacture/model groups, aircraft type, state, and region of based aircraft and primary use are presented. Also included are fuel consumption, lifetime airframe hours, avionics, engine hours, miles flown estimates, tables for detailed analysis of the avionics capability of the general aviation fleet, estimates of the number of landings, IFR hours flown, and grade of fuel consumed by the general aviation fleet. GRA

N92-13927# Federal Aviation Administration, Washington, DC. Office of Management Systems.
FAA STATISTICAL HANDBOOK OF AVIATION: CALENDAR YEAR 1989
1989 142 p
(PB91-202051; FAA-AMS-420) Avail: NTIS HC/MF A07 CSCL 01B

Statistical information pertaining to the Federal Aviation Administration, the National Airspace System, airports, airport activity, aircraft accidents, aeronautical production and imports/exports, and a glossary of the terms used in the publication are presented. GRA

N92-13928*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
THIRD INTERNATIONAL CONFERENCE ON INVERSE DESIGN CONCEPTS AND OPTIMIZATION IN ENGINEERING SCIENCES (ICIDES-3)
George S. Dulikravich, ed. 1991 608 p Conference held in Washington, DC, 23-25 Oct. 1991 Sponsored in cooperation with NASA, Washington, NSF, and ONR
(NASA-CR-188125; NAS 1.26:188125) Avail: NTIS HC/MF A99 CSCL 01B

Papers from the Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES) are presented. The papers discuss current research in the general field of inverse, semi-inverse, and direct design and optimization in engineering sciences. The rapid growth of this relatively new field is due to the availability of faster and larger computing machines. For individual titles, see N92-13929 through N92-13974.

N92-13929*# National Aerospace Lab., Amsterdam (Netherlands).
REVIEW OF AERODYNAMIC DESIGN IN THE NETHERLANDS **c05**
Th. E. Labrujere *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 1-30 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

Aerodynamic design activities in the Netherlands, which take place mainly at Fokker, the National Aerospace Laboratory (NLR), and Delft University of Technology (TUD), are discussed. The survey concentrates on the development of the Fokker 100 wing, glider design at TUD, and research at NLR in the field of aerodynamic design. Results are shown to illustrate these activities. Author

N92-13930*# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
AERODYNAMIC AIRCRAFT DESIGN METHODS AND THEIR NOTABLE APPLICATIONS: SURVEY OF THE ACTIVITY IN JAPAN **c05**
Kozo Fujii and Susumu Takanashi (National Aerospace Lab., Tokyo, Japan) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 31-44 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

An overview of aerodynamic aircraft design methods and their recent applications in Japan is presented. A design code which was developed at the National Aerospace Laboratory (NAL) and is in use now is discussed, hence, most of the examples are the result of the collaborative work between heavy industry and the National Aerospace Laboratory. A wide variety of applications in transonic to supersonic flow regimes are presented. Although design of aircraft elements for external flows are the main focus, some of the internal flow applications are also presented. Recent applications of the design code, using the Navier Stokes and Euler equations in the analysis mode, include the design of HOPE (a space vehicle) and Upper Surface Blowing (USB) aircraft configurations. Author

N92-13931*# Aviation Inst., Bucharest (Romania).
ON A GLOBAL AERODYNAMIC OPTIMIZATION OF A CIVIL TRANSPORT AIRCRAFT **c05**
G. Savu and O. Trifu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 45-54 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

An aerodynamic optimization procedure developed to minimize the drag to lift ratio of an aircraft configuration: wing - body - tail, in accordance with engineering restrictions, is described. An algorithm developed to search a hypersurface with 18 dimensions, which define an aircraft configuration, is discussed. The results, when considered from the aerodynamic point of view, indicate the optimal configuration is one that combines a lifting fuselage with a canard. Author

N92-13932*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVERSE AIRFOIL DESIGN PROCEDURE USING A MULTIGRID NAVIER-STOKES METHOD **c05**
J. B. Malone and R. C. Swanson *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 55-66 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

The Modified Garabedian McFadden (MGM) design procedure was incorporated into an existing 2-D multigrid Navier-Stokes airfoil analysis method. The resulting design method is an iterative procedure based on a residual correction algorithm and permits the automated design of airfoil sections with prescribed surface pressure distributions. The new design method, Multigrid Modified Garabedian McFadden (MG-MGM), is demonstrated for several different transonic pressure distributions obtained from both symmetric and cambered airfoil shapes. The airfoil profiles generated with the MG-MGM code are compared to the original configurations to assess the capabilities of the inverse design method. Author

N92-13933*# Boeing Computer Services Co., Seattle, WA.
A COMPARISON OF TWO CLOSELY-RELATED APPROACHES TO AERODYNAMIC DESIGN OPTIMIZATION **c05**
G. R. Shubin and P. D. Frank *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 67-78 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

Two related methods for aerodynamic design optimization are compared. The methods, called the implicit gradient approach and the variational (or optimal control) approach, both attempt to obtain gradients necessary for numerical optimization at a cost significantly less than that of the usual black-box approach that employs finite difference gradients. While the two methods are seemingly quite different, they are shown to differ (essentially) in that the order of discretizing the continuous problem, and of applying calculus, is interchanged. Under certain circumstances, the two methods turn out to be identical. We explore the relationship between these methods by applying them to a model problem for duct flow that has many features in common with transonic flow over an airfoil. We find that the gradients computed by the variational method can sometimes be sufficiently inaccurate to cause the optimization to fail. Author

N92-13934*# Alabama Univ., Tuscaloosa. Dept. of Aerospace Engineering.
DESIGN OF THRUST VECTORING EXHAUST NOZZLES FOR REAL-TIME APPLICATIONS USING NEURAL NETWORKS **c07**
Ravi K. Prasanth, Robert E. Markin, and Kevin W. Whitaker *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 79-86 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

Thrust vectoring continues to be an important issue in military aircraft system designs. A recently developed concept of vectoring aircraft thrust makes use of flexible exhaust nozzles. Subtle modifications in the nozzle wall contours produce a non-uniform flow field containing a complex pattern of shock and expansion waves. The end result, due to the asymmetric velocity and pressure distributions, is vectored thrust. Specification of the nozzle contours required for a desired thrust vector angle (an inverse design problem) has been achieved with genetic algorithms. This approach is computationally intensive and prevents the nozzles from being designed in real-time, which is necessary for an operational aircraft system. An investigation was conducted into using genetic algorithms to train a neural network in an attempt to obtain, in real-time, two-dimensional nozzle contours. Results show that genetic algorithm trained neural networks provide a viable, real-time alternative for designing thrust vectoring nozzles contours. Thrust vector angles up to 20 deg were obtained within an average error of 0.0914 deg. The error surfaces encountered were highly degenerate and thus the robustness of genetic algorithms was well suited for minimizing global errors. Author

N92-13935*# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
FINITE ELEMENT STRUCTURAL REDESIGN BY LARGE ADMISSIBLE PERTURBATIONS **c39**
Michael M. Bernitsas, E. Beyko, C. W. Rim, and B. Alzahabi *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 87-98 (For primary document see N92-13928 05-01)
(Contract N00014-90-J-4081)
Avail: NTIS HC/MF A99 CSCL 20K

In structural redesign, two structural states are involved; the baseline (known) State S1 with unacceptable performance, and the objective (unknown) State S2 with given performance specifications. The difference between the two states in performance and design variables may be as high as 100 percent or more depending on the scale of the structure. A Perturbation Approach to Redesign (PAR) is presented to relate any two structural states S1 and S2 that are modeled by the same finite element model and represented by different values of the design variables. General perturbation equations are derived expressing implicitly the natural frequencies, dynamic modes, static deflections, static stresses, Euler buckling loads, and buckling modes of the objective S2 in terms of its performance specifications, and S1 data and Finite Element Analysis (FEA) results. Large Admissible Perturbation (LEAP) algorithms are implemented in code RESTRUCT to define the objective S2 incrementally without trial and error by postprocessing FEA results of S1 with no additional FEAs. Systematic numerical applications in redesign of a 10 element 48 degree of freedom (dof) beam, a 104 element 192 dof offshore tower, a 64 element 216 dof plate, and a 144 element 896 dof cylindrical shell show the accuracy, efficiency, and potential of PAR to find an objective state that may differ 100 percent from the baseline design. Author

N92-13936*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
STRUCTURAL DAMAGE IDENTIFICATION USING MATHEMATICAL OPTIMIZATION TECHNIQUES **c39**
Mo-How Herman Shen *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 99-110 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20K

An identification procedure is proposed to identify damage characteristics (location and size of the damage) from dynamic measurements. This procedure was based on minimization of the mean-square measure of difference between measurement data (natural frequencies and mode shapes) and the corresponding predictions obtained from the computational model. The procedure is tested for simulated damage in the form of stiffness changes in a simple fixed free spring mass system and symmetric cracks in a simply supported Bernoulli Euler beam. It is shown that when all the mode information is used in the identification procedure it is possible to uniquely determine the damage properties. Without knowing the complete set of modal information, a restricted region in the initial data space has been found for realistic and convergent solution from the identification process. Author

N92-13937*# Rensselaer Polytechnic Inst., Troy, NY. Center for Multiphase Research.
ELECTRICAL IMPEDANCE IMAGING IN TWO-PHASE, GAS-LIQUID FLOWS: 1. INITIAL INVESTIGATION **c34**
J. T. Lin, L. Ovacik, and O. C. Jones *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 111-122 Sponsored in part by Hitachi, Ltd., Ibaraki, Japan

(For primary document see N92-13928 05-01)
(Contract DE-FG07-90ER-13032)
Avail: NTIS HC/MF A99 CSCL 20D

The determination of interfacial area density in two-phase, gas-liquid flows is one of the major elements impeding significant development of predictive tools based on the two-fluid model. Currently, these models require coupling of liquid and vapor at interfaces using constitutive equations which do not exist in any but the most rudimentary form. Work described herein represents the first step towards the development of Electrical Impedance Computed Tomography (EICT) for nonintrusive determination of interfacial structure and evolution in such flows. Author

N92-13938*# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Cincinnati, OH.

RECENT PROGRESS IN INVERSE METHODS IN FRANCE c07

Pierre-Francois Bry, Olivier-Pierre Jacquotte, and Marie-Claire LePape (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 123-144 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

Given the current level of jet engine performance, improvement of the various turbomachinery components requires the use of advanced methods in aerodynamics, heat transfer, and aeromechanics. In particular, successful blade design can only be achieved via numerical design methods which make it possible to reach optimized solutions in a much shorter time than ever before. Two design methods which are currently being used throughout the French turbomachinery industry to obtain optimized blade geometries are presented. Examples are presented for compressor and turbine applications. The status of these methods as far as improvement and extension to new fields of applications is also reported. Author

N92-13939*# Shanghai Inst. of Mechanical Engineering (China). Lab. of Turbomachinery Aerodynamics.

RESEARCH ON INVERSE, HYBRID AND OPTIMIZATION PROBLEMS IN ENGINEERING SCIENCES WITH EMPHASIS ON TURBOMACHINE AERODYNAMICS: REVIEW OF CHINESE ADVANCES c07

Gao-Lian Liu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 145-163 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

Advances in inverse design and optimization theory in engineering fields in China are presented. Two original approaches, the image-space approach and the variational approach, are discussed in terms of turbomachine aerodynamic inverse design. Other areas of research in turbomachine aerodynamic inverse design include the improved mean-streamline (stream surface) method and optimization theory based on optimal control. Among the additional engineering fields discussed are the following: the inverse problem of heat conduction, free-surface flow, variational cogeneration of optimal grid and flow field, and optimal meshing theory of gears. Author

N92-13940*# Centre National de la Recherche Scientifique, Orsay (France).

THE TURBOMACHINE BLADING DESIGN USING S2-S1 APPROACH c07

T. S. Luu, L. Bencherif, B. Viney, and J. M. Nguyen Duc (Societe Europeenne de Propulsion, Vernon, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 165-176 Sponsored in part by Societe Europeenne de Propulsion (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

The boundary conditions corresponding to the design problem when the blades being simulated by the bound vorticity distribution are presented. The 3D flow is analyzed by the two steps S2 - S1 approach. In the first step, the number of blades is supposed to be infinite, the vortex distribution is transformed into an axisymmetric one, so that the flow field can be analyzed in a meridional plane. The thickness distribution of the blade producing the flow channel striction is taken into account by the modification of metric tensor in the continuity equation. Using the meridional stream function to define the flow field, the mass conservation is satisfied automatically. The governing equation is deduced from the relation between the azimuthal component of the vorticity and the meridional velocity. The value of the azimuthal component of the vorticity is provided by the hub to shroud equilibrium condition. This step leads to the determination of the axisymmetric stream sheets as well as the approximate camber surface of the blade. In the second step, the finite number of blades is taken into account, the inverse problem corresponding to the blade to blade flow confined in each stream sheet is analyzed. The momentum equation implies that the free vortex of the absolute velocity must be tangential to the stream sheet. The governing equation for the blade to blade flow stream function is deduced from this condition. At the beginning, the upper and the lower surfaces of the blades are created from the camber surface obtained from the first step with the assigned thickness distribution. The bound vorticity distribution and the penetrating flux conservation applied on the presumed blade surface constitute the boundary conditions of the inverse problem. The detection of this flux leads to the rectification of the geometry of the blades. Author

N92-13941*# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.

A PROPOSED THROUGH-FLOW INVERSE METHOD FOR THE DESIGN OF MIXED-FLOW PUMPS c37

Joao Eduardo Borges *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 177-188 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13I

A through-flow (hub-to-shroud) truly inverse method is proposed and described. It uses an imposition of mean swirl, i.e., radius times mean tangential velocity, given throughout the meridional section of the turbomachine as an initial design specification. In the present implementation, it is assumed that the fluid is inviscid, incompressible, and irrotational at inlet and that the blades are supposed to have zero thickness. Only blade rows that impart to the fluid a constant work along the space are considered. An application of this procedure to design the rotor of a mixed-flow pump is described in detail. The strategy used to find a suitable mean swirl distribution and the other design inputs is also described. The final blade shape and pressure distributions on the blade surface are presented, showing that it is possible to obtain feasible designs using this technique. Another advantage of this technique is the fact that it does not require large amounts of CPU time. Author

N92-13942*# National Technical Univ., Athens (Greece). Lab. of Thermal Turbomachines.

AN INVERSE INVISCID METHOD FOR THE DESIGN OF QUASI-THREE DIMENSIONAL ROTATING TURBOMACHINERY CASCADES c07

E. Bonataki, P. Chaviaropoulos, and K. D. Papailiou *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 189-200 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

A new inverse inviscid method suitable for the design of rotating blade sections lying on an arbitrary axisymmetric stream-surface with varying streamtube width is presented. The geometry of the axisymmetric stream-surface and the streamtube width variation with meridional distance, the number of blades, the inlet flow conditions, the rotational speed and the suction and pressure side velocity distributions as functions of the normalized arc-length are given. The flow is considered irrotational in the absolute frame of reference and compressible. The output of the computation is the

blade section that satisfies the above data. The method solves the flow equations on a (phi 1, psi) potential function-streamfunction plane for the velocity modulus, W and the flow angle beta; the blade section shape can then be obtained as part of the physical plane geometry by integrating the flow angle distribution along streamlines. The (phi 1, psi) plane is defined so that the monotonic behavior of the potential function is guaranteed, even in cases with high peripheral velocities. The method is validated on a rotating turbine case and used to design new blades. To obtain a closed blade, a set of closure conditions were developed and referred. Author

N92-13943*# Skoe (Ivar Helge), Kongsberg (Norway).
A PC-BASED INVERSE DESIGN METHOD FOR RADIAL AND MIXED FLOW TURBOMACHINERY c07
Ivar Helge Skoe *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 201-212 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

An Inverse Design Method suitable for radial and mixed flow turbomachinery is presented. The codes are based on the streamline curvature concept; therefore, it is applicable for current personal computers from the 286/287 range. In addition to the imposed aerodynamic constraints, mechanical constraints are imposed during the design process to ensure that the resulting geometry satisfies production consideration and that structural considerations are taken into account. By the use of Bezier Curves in the geometric modeling, the same subroutine is used to prepare input for both aero and structural files since it is important to ensure that the geometric data is identical to both structural analysis and production. To illustrate the method, a mixed flow turbine design is shown. Author

N92-13944*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
OPTIMAL DESIGN OF SOLIDIFICATION PROCESSES c76
Jonathan A. Dantzig and Daniel A. Tortorelli *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 213-225 (For primary document see N92-13928 05-01)
(Grants NAGw-1683; NAG3-1286)
Avail: NTIS HC/MF A99 CSCL 20L

An optimal design algorithm is presented for the analysis of general solidification processes, and is demonstrated for the growth of GaAs crystals in a Bridgman furnace. The system is optimal in the sense that the prespecified temperature distribution in the solidifying materials is obtained to maximize product quality. The optimization uses traditional numerical programming techniques which require the evaluation of cost and constraint functions and their sensitivities. The finite element method is incorporated to analyze the crystal solidification problem, evaluate the cost and constraint functions, and compute the sensitivities. These techniques are demonstrated in the crystal growth application by determining an optimal furnace wall temperature distribution to obtain the desired temperature profile in the crystal, and hence to maximize the crystal's quality. Several numerical optimization algorithms are studied to determine the proper convergence criteria, effective 1-D search strategies, appropriate forms of the cost and constraint functions, etc. In particular, we incorporate the conjugate gradient and quasi-Newton methods for unconstrained problems. The efficiency and effectiveness of each algorithm is presented in the example problem. Author

N92-13945*# Cincinnati Univ., OH. Dept. of Mathematical Sciences.
NUMERICAL IDENTIFICATION OF BOUNDARY CONDITIONS ON NONLINEARLY RADIATING INVERSE HEAT CONDUCTION PROBLEMS c34
Diego A. Murio *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 227-238 Sponsored in part by a W. Taft Fellowship (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

An explicit and unconditionally stable finite difference method for the solution of the transient inverse heat conduction problem in a semi-infinite or finite slab mediums subject to nonlinear radiation boundary conditions is presented. After measuring two interior temperature histories, the mollification method is used to determine the surface transient heat source if the energy radiation law is known. Alternatively, if the active surface is heated by a source at a rate proportional to a given function, the nonlinear surface radiation law is then recovered as a function of the interface temperature when the problem is feasible. Two typical examples corresponding to Newton cooling law and Stefan-Boltzmann radiation law respectively are illustrated. In all cases, the method predicts the surface conditions with an accuracy suitable for many practical purposes. Author

N92-13946*# Cincinnati Univ., OH. Dept. of Mathematical Sciences.
COMPARISON OF FOUR STABLE NUMERICAL METHODS FOR ABEL'S INTEGRAL EQUATION c64
Diego A. Murio and Carlos E. Mejia *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 239-252 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 12A

The 3-D image reconstruction from cone-beam projections in computerized tomography leads naturally, in the case of radial symmetry, to the study of Abel-type integral equations. If the experimental information is obtained from measured data, on a discrete set of points, special methods are needed in order to restore continuity with respect to the data. A new combined Regularized-Adjoint-Conjugate Gradient algorithm, together with two different implementations of the Mollification Method (one based on a data filtering technique and the other on the mollification of the kernal function) and a regularization by truncation method (initially proposed for 2-D ray sample schemes and more recently extended to 3-D cone-beam image reconstruction) are extensively tested and compared for accuracy and numerical stability as functions of the level of noise in the data. Author

N92-13947*# Kazan State Univ. (USSR). Dept. of Applied Mathematics.
OPTIMIZATION OF THE HEATING SURFACE SHAPE IN THE CONTACT MELTING PROBLEM c31
Sergei A. Fomin and Shangmo Cheng (Huazhong Univ. of Science and Technology, Wuhan, China) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 253-262 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13B

The theoretical analysis of contact melting by the migrating heat source with an arbitrary shaped isothermal heating surface is presented. After the substantiated simplification, the governing equations are transformed to the convenient equations for engineering calculations relationships. Analytical solutions are used for numerical prediction of optimal shape of the heating surface. The problem is investigated for the constant and for temperature dependent physical properties of the melt. Author

N92-13948*# Warsaw Technical Univ. (Poland). Inst. of Applied Mechanics and Aviation Technology.
DESIGN OF 3-DIMENSIONAL COMPLEX AIRPLANE CONFIGURATIONS WITH SPECIFIED PRESSURE DISTRIBUTION VIA OPTIMIZATION c05
Krzysztof Kubrynski *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 263-280 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

A subcritical panel method applied to flow analysis and aerodynamic design of complex aircraft configurations is presented.

The analysis method is based on linearized, compressible, subsonic flow equations and indirect Dirichlet boundary conditions. Quadratic dipol and linear source distribution on flat panels are applied. In the case of aerodynamic design, the geometry which minimizes differences between design and actual pressure distribution is found iteratively, using numerical optimization technique. Geometry modifications are modeled by surface transpiration concept. Constraints in respect to resulting geometry can be specified. A number of complex 3-dimensional design examples are presented. The software is adopted to personal computers, and as result an unexpected low cost of computations is obtained. Author

N92-13949*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Inst. of Theoretical Fluid Mechanics.

EXTENDED MAPPING AND CHARACTERISTICS TECHNIQUES FOR INVERSE AERODYNAMIC DESIGN **c05**

H. Sobieczky and Y. J. Qian *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 281-292 (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 01C

Some ideas for using hodograph theory, mapping techniques and methods of characteristics to formulate typical aerodynamic design boundary value problems are developed. The inverse method of characteristics is shown to be a fast tool for design of transonic flow elements as well as supersonic flows with given shock waves. Author

N92-13950*# Stuttgart Univ. (Germany, F.R.). Inst. fuer Aerodynamik und Gasdynamik.

SUPERCRITICAL BLADE DESIGN ON STREAM SURFACES OF REVOLUTION WITH AN INVERSE METHOD **c34**

E. Schmidt and H.-D. Grein *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 293-305 (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 20D

A method to solve the inverse problem of supercritical blade-to-blade flow on stream surfaces of revolution with variable radius and variable stream surface thickness in a relative system is described. Some aspects of shockless design and of leading edge resolution in the numerical procedure are depicted. Some supercritical compressor cascades were designed and their complete flow field results were compared with computations of two different analysis methods. Author

N92-13951*# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.). Dept. of Aerodynamics.

APPLICATION OF DIRECT INVERSE ANALOGY METHOD (DIVA) AND VISCOUS DESIGN OPTIMIZATION TECHNIQUES **c02**

E. Greff, D. Forbrich, and H. Schwarten *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 307-324 (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 01A

A direct-inverse approach to the transonic design problem was presented in its initial state at the First International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-1). Further applications of the direct inverse analogy (DIVA) method to the design of airfoils and incremental wing improvements and experimental verification are reported. First results of a new viscous design code also from the residual correction type with semi-inverse boundary layer coupling are compared with DIVA which may enhance the accuracy of trailing edge design for highly loaded airfoils. Finally, the capabilities of an optimization routine coupled with the two viscous full potential solvers are investigated in comparison to the inverse method. Author

N92-13952*# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

BLADE DESIGN AND ANALYSIS USING A MODIFIED EULER SOLVER **c07**

O. Leonard and R. A. VandenBraembussche *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 325-336 (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 21E

An iterative method for blade design based on Euler solver and described in an earlier paper is used to design compressor and turbine blades providing shock free transonic flows. The method shows a rapid convergence, and indicates how much the flow is sensitive to small modifications of the blade geometry, that the classical iterative use of analysis methods might not be able to define. The relationship between the required Mach number distribution and the resulting geometry is discussed. Examples show how geometrical constraints imposed upon the blade shape can be respected by using free geometrical parameters or by relaxing the required Mach number distribution. The same code is used both for the design of the required geometry and for the off-design calculations. Examples illustrate the difficulty of designing blade shapes with optimal performance also outside of the design point. Author

N92-13953*# Shanghai Inst. of Mechanical Engineering (China). Lab. of Turbomachinery Aerodynamics.

VARIATIONAL FORMULATION OF HYBRID PROBLEMS FOR FULLY 3-D TRANSONIC FLOW WITH SHOCKS IN ROTOR **c02**

Gao-Lian Liu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 337-346 Sponsored in part by the National Natural Science Foundation, Peoples Republic of China (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 01A

Based on previous research, the unified variable domain variational theory of hybrid problems for rotor flow is extended to fully 3-D transonic rotor flow with shocks, unifying and generalizing the direct and inverse problems. Three variational principles (VP) families were established. All unknown boundaries and flow discontinuities (such as shocks, free trailing vortex sheets) are successfully handled via functional variations with variable domain, converting almost all boundary and interface conditions, including the Rankine Hugoniot shock relations, into natural ones. This theory provides a series of novel ways for blade design or modification and a rigorous theoretical basis for finite element applications and also constitutes an important part of the optimal design theory of rotor bladings. Numerical solutions to subsonic flow by finite elements with self-adapting nodes given in Refs., show good agreement with experimental results. Author

N92-13954*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

AERODYNAMIC SHAPE OPTIMIZATION OF ARBITRARY HYPERSONIC VEHICLES **c05**

George S. Dulikravich and Scott G. Sheffer *In its* Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 347-358 Sponsored in part by Pennsylvania State Univ., University Park (For primary document see N92-13928 05-01)

Avail: NTIS HC/MF A99 CSCL 01C

A new method was developed to optimize, in terms of aerodynamic wave drag minimization, arbitrary (nonaxisymmetric) hypersonic vehicles in modified Newtonian flow, while maintaining the initial volume and length of the vehicle. This new method uses either a surface fitted Fourier series to represent the vehicle's geometry or an independent point motion algorithm. In either case, the coefficients of the Fourier series or the spatial locations of the points defining each cross section were varied and a numerical optimization algorithm based on a quasi-Newton gradient search

concept was used to determine the new optimal configuration. Results indicate a significant decrease in aerodynamic wave drag for simple and complex geometries at relatively low CPU costs. In the case of a cone, the results agreed well with known analytical optimum ogive shapes. The procedure is capable of accepting more complex flow field analysis codes. Author

N92-13955*# Windsor Univ. (Ontario). Dept. of Mathematics and Statistics.

ANALYSIS AND DESIGN OF TRANSONIC AIRFOILS USING STREAMWISE COORDINATES **c05**

R. M. Barron and C.-F. An *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 359-370 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

A new approach is developed for analysis and design of transonic airfoils. A set of full potential equivalent equations in von Mises coordinates is formulated from the Euler equations under the irrotationality and isentropic assumptions. This set is composed of a main equation for the main variable, y, and a secondary equations for the secondary variable, R. The main equation is solved by type dependent differencing combined with a shock point operator. The secondary equation is solved by marching from a non-characteristic boundary. Sample computations on NACA 0012 and biconvex airfoils show that, for the analysis problem, the present approach achieves good agreement with experimental C sub p distributions. For the design problem, the approach leads to a simple numerical algorithm in which the airfoil contour is calculated as part of the flow field solution. Author

N92-13956*# Fiat Aviazione S.p.A., Turin (Italy).

RESEARCH ON INVERSE METHODS AND OPTIMIZATION IN ITALY **c07**

Francesco Larocca *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 371-390 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

The research activities in Italy on inverse design and optimization are reviewed. The review is focused on aerodynamic aspects in turbomachinery and wing section design. Inverse design of blade rows and ducts of turbomachinery in subsonic and transonic regime are illustrated by the Politecnico di Torino and turbomachinery industry (FIAT AVIO). Author

N92-13957*# Columbia Univ., New York, NY. Dept. of Mechanical Engineering.

ADJOINT OPERATOR APPROACH TO SHAPE DESIGN FOR INTERNAL INCOMPRESSIBLE FLOWS **c34**

H. Cabuk, C.-H. Sung (David Taylor Research Center, Bethesda, MD.), and V. Modi *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 391-404 (For primary document see N92-13928 05-01)
(Grant NSF CBT-87-10561)
Avail: NTIS HC/MF A99 CSCL 20D

The problem of determining the profile of a channel or duct that provides the maximum static pressure rise is solved. Incompressible, laminar flow governed by the steady state Navier-Stokes equations is assumed. Recent advances in computational resources and algorithms have made it possible to solve the direct problem of determining such a flow through a body of known geometry. It is possible to obtain a set of adjoint equations, the solution to which permits the calculation of the direction and relative magnitude of change in the diffuser profile that leads to a higher pressure rise. The solution to the adjoint problem can be shown to represent an artificially constructed flow. This interpretation provides a means to construct numerical solutions to the adjoint equations that do not compromise the fully viscous nature of the problem. The algorithmic and computational aspects of solving the adjoint equations are addressed. The form of these set of equations is similar but not identical to the Navier-Stokes equations. In particular some issues related to boundary conditions and stability are discussed. Author

N92-13958*# General Electric Co., Cincinnati, OH. Aircraft Engines.

AN INVERSE METHOD FOR THE AERODYNAMIC DESIGN OF THREE-DIMENSIONAL AIRCRAFT ENGINE NACELLES **c05**

R. A. Bell and R. D. Cedar *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 405-417 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

A fast, efficient and user friendly inverse design system for 3-D nacelles was developed. The system is a product of a 2-D inverse design method originally developed at NASA-Langley and the CFL3D analysis code which was also developed at NASA-Langley and modified for nacelle analysis. The design system uses a predictor/corrector design approach in which an analysis code is used to calculate the flow field for an initial geometry, the geometry is then modified based on the difference between the calculated and target pressures. A detailed discussion of the design method, the process of linking it to the modified CFL3D solver and its extension to 3-D is presented. This is followed by a number of examples of the use of the design system for the design of both axisymmetric and 3-D nacelles. Author

N92-13959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

VORTEX GENERATOR DESIGN FOR AIRCRAFT INLET DISTORTION AS A NUMERICAL OPTIMIZATION PROBLEM **c05**

Bernhard H. Anderson and Ralph Levy (Scientific Research Associates, Inc., Glastonbury, CT.) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 419-431 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

Aerodynamic compatibility of aircraft/inlet/engine systems is a difficult design problem for aircraft that must operate in many different flight regimes. Takeoff, subsonic cruise, supersonic cruise, transonic maneuvering, and high altitude loiter each place different constraints on inlet design. Vortex generators, small wing like sections mounted on the inside surfaces of the inlet duct, are used to control flow separation and engine face distortion. The design of vortex generator installations in an inlet is defined as a problem addressable by numerical optimization techniques. A performance parameter is suggested to account for both inlet distortion and total pressure loss at a series of design flight conditions. The resulting optimization problem is difficult since some of the design parameters take on integer values. If numerical procedures could be used to reduce multimillion dollar development test programs to a small set of verification tests, numerical optimization could have a significant impact on both cost and elapsed time to design new aircraft. Author

N92-13960*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

AIRFOIL OPTIMIZATION WITH EFFICIENT GRADIENT CALCULATIONS **c02**

Thomas Sorensen *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 433-444 Sponsored in part by MIT and NSF (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20N

The viscous airfoil design analysis code XFOIL was extended to allow optimization using conformal mapping coefficients as design variables. The optimization technique used was the Steepest Descent method applied to a Penalty Function. The gradients of the aerodynamic variables with respect to the design variables were cheaply calculated as by-products of XFOIL's integral boundary layer Newton solver. The speed of the optimization

process further increased by updating the Newton system boundary layer variables after each optimization step using the available gradient information. Two examples are presented. Author

N92-13961*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
DESIGN OPTIMIZATION OF TRANSONIC AIRFOILS c02
C.-Y. Joh, B. Grossman, and R. T. Haftka *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 445-456 (For primary document see N92-13928 05-01)
(Grant NSF DMC-86-15336)
Avail: NTIS HC/MF A99 CSCL 01A

Numerical optimization procedures were considered for the design of airfoils in transonic flow based on the transonic small disturbance (TSD) and Euler equations. A sequential approximation optimization technique was implemented with an accurate approximation of the wave drag based on the Nixon's coordinate straining approach. A modification of the Euler surface boundary conditions was implemented in order to efficiently compute design sensitivities without remeshing the grid. Two effective design procedures producing converged designs in approximately 10 global iterations were developed: interchanging the role of the objective function and constraint and the direct lift maximization with move limits which were fixed absolute values of the design variables. Author

N92-13962*# Khmelnitsky Technological Inst. (USSR).
IDENTIFICATION OF DYNAMIC CHARACTERISTICS OF FLEXIBLE ROTORS AS DYNAMIC INVERSE PROBLEM c34
W. P. Roisman and L. D. Vajingortin *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 457-468 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

The problem of dynamic and balancing of flexible rotors were considered, which were set and solved as the problem of the identification of flexible rotor systems, which is the same as the inverse problem of the oscillation theory dealing with the task of the identifying the outside influences and system parameters on the basis of the known laws of motion. This approach to the problem allows the disclosure the picture of disbalances throughout the rotor-under-test (which traditional methods of flexible rotor balancing, based on natural oscillations, could not provide), and identify dynamic characteristics of the system, which correspond to a selected mathematical model. Eventually, various methods of balancing were developed depending on the special features of the machines as to their design, technology, and operation specifications. Also, theoretical and practical methods are given for the flexible rotor balancing at far from critical rotation frequencies, which does not necessarily require the knowledge forms of oscillation, dissipation, and elasticity and inertia characteristics, and to use testing masses. Author

N92-13963*# Khmelnitsky Technological Inst. (USSR).
ON DESIGNING FOR QUALITY c38
L. D. Vajingortin and W. P. Roisman *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 469-480 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 14D

The problem of ensuring the required quality of products and/or technological processes often becomes more difficult due to the fact that there is not general theory of determining the optimal sets of value of the primary factors, i.e., of the output parameters of the parts and units comprising an object and ensuring the correspondence of the object's parameters to the quality requirements. This is the main reason for the amount of time taken to finish complex vital article. To create this theory, one has to overcome a number of difficulties and to solve the following tasks: the creation of reliable and stable mathematical models showing the influence of the primary factors on the output parameters; finding a new technique of assigning tolerances for primary factors with regard to economical, technological, and other criteria, the technique being based on the solution of the main problem; well reasoned assignment of nominal values for primary factors which serve as the basis for creating tolerances. Each of the above listed tasks is of independent importance. An attempt is made to give solutions for this problem. The above problem dealing with quality ensuring an mathematically formalized aspect is called the multiple inverse problem. Author

N92-13964*# Academy of Sciences (USSR), Perm. Inst. of Continuous Media Mechanics.
OPTIMAL INTERACTION OF INDENTER WITH INHOMOGENEOUS PLATE c37
Valery N. Aptukov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 481-488 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13I

Consideration is given to a new class of problems dealing with an optimal design of an inhomogeneous plate during dynamic penetration of the rigid indenter. The quality criterion of the process is defined by the specific mass of the target, which absorbs the given kinetic mass of the indenter. Parameters of control are expressed in terms of mechanical characteristics, i.e., distribution of density and the related hardness across the plate thickness. The maximum principle of Pontryagin is used to search for the piecewise continuous control function. With consideration of impact conditions and characteristics for a given class of material, an optimal target structure criterion was estimated for engineering applications. Author

N92-13965*# Academy of Sciences (USSR), Perm. Inst. of Continuous Media Mechanics.
ANALYSIS OF THE OPTIMAL LAMINATED TARGET MADE UP OF DISCRETE SET OF MATERIALS c24
Valery N. Aptukov and Valentin L. Belousov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 489-494 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 11D

A new class of problems was analyzed to estimate an optimal structure of laminated targets fabricated from the specified set of homogeneous materials. An approximate description of the perforation process is based on the model of radial hole extension. The problem is solved by using the needle-type variation technique. The desired optimization conditions and quantitative/qualitative estimations of optimal targets were obtained and are discussed using specific examples. Author

N92-13966*# Moscow Inst. of Aviation Technology (USSR). Dept. of Space System Engineering and Design.
INVERSE PROBLEMS IN THE DESIGN, MODELING AND TESTING OF ENGINEERING SYSTEMS c31
Oleg M. Alifanov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 495-512 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13B

Formulations, classification, areas of application, and approaches to solving different inverse problems are considered for the design of structures, modeling, and experimental data processing. Problems in the practical implementation of theoretical-experimental methods based on solving inverse problems are analyzed in order to identify mathematical models of physical processes, aid in input data preparation for design parameter optimization, help in design parameter optimization itself, and to model experiments, large-scale tests, and real tests of engineering systems. Author

N92-13967*# Moscow Inst. of Aviation Technology (USSR). Dept. of Space System Engineering and Design.
INVERSE PROBLEMS AND OPTIMAL EXPERIMENT DESIGN IN UNSTEADY HEAT TRANSFER PROCESSES IDENTIFICATION **c34**
Eugene A. Artyukhin *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 513-530 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

Experimental-computational methods for estimating characteristics of unsteady heat transfer processes are analyzed. The methods are based on the principles of distributed parameter system identification. The theoretical basis of such methods is the numerical solution of nonlinear ill-posed inverse heat transfer problems and optimal experiment design problems. Numerical techniques for solving problems are briefly reviewed. The results of the practical application of identification methods are demonstrated when estimating effective thermophysical characteristics of composite materials and thermal contact resistance in two-layer systems. Author

N92-13968*# Xian Jiaotong Univ. (China). Dept. of Power Mach. Eng.
A NEW METHOD OF OPTIMAL DESIGN FOR A TWO-DIMENSIONAL DIFFUSER BY USING DYNAMIC PROGRAMMING **c02**
Chuangang Gu, Moujin Zhang, Xi Chen, and Yongmiao Miao *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 531-540 (For primary document see N92-13928 05-01)
(Contract NSFC-C-59076261)
Avail: NTIS HC/MF A99 CSCL 01A

A new method for predicting the optimal velocity distribution on the wall of a two dimensional diffuser is presented. The method uses dynamic programming to solve the optimal control problem with inequality constraints of state variables. The physical model of optimization is designed to prevent the separation of the boundary layer while approaching the maximum pressure ratio in a diffuser of a specified length. The computational results are in fair agreement with the experimental ones. Optimal velocity distribution on a diffuser wall is said to occur when the flow decelerates quickly at first and then smoothly, while the flow is near separation, but always protected from it. The optimal velocity distribution can be used to design the contour of the diffuser. Author

N92-13969*# Beijing Univ. (China). Inst. of Fluid Mechanics.
AN INVERSE METHOD WITH REGULARITY CONDITION FOR TRANSONIC AIRFOIL DESIGN **c02**
Ziqiang Zhu, Zhixun Xia, and Liyi Wu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 541-552 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

It is known from Lighthill's exact solution of the incompressible inverse problem that in the inverse design problem, the surface pressure distribution and the free stream speed cannot both be prescribed independently. This implies the existence of a constraint on the prescribed pressure distribution. The same constraint exists at compressible speeds. Presented here is an inverse design method for transonic airfoils. In this method, the target pressure distribution contains a free parameter that is adjusted during the computation to satisfy the regularity condition. Some design results are presented in order to demonstrate the capabilities of the method. Author

N92-13970*# Xian Jiaotong Univ. (China).
STUDY OF A NEW AIRFOIL USED IN REVERSIBLE AXIAL FANS **c02**
Chaojun Li, Baosuo Wei, and Chuangang Gu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 553-562 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

The characteristics of the reverse ventilation of axial flow are analyzed. An s shaped airfoil with a double circular arc was tested in a wind tunnel. The experimental results showed that the characteristics of this new airfoil in reverse ventilation are the same as those in normal ventilation, and that this airfoil is better than the existing airfoils used on reversible axial fans. Author

N92-13971*# Academy of Sciences (USSR), Moscow. Inst. for Problems in Mechanics.
INVERSE PROBLEMS IN DIFFRACTION **c32**
Andrew G. Mikheev and Aleksey S. Shamaev *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 563-572 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20N

A two-dimensional problem of diffraction of a plane electromagnetic wave on a smooth 2 pi-periodic surface is considered. A numerical algorithm solving this problem is developed. An inverse problem of determination of the shape of 2 pi-periodic surface using the performance data of reverse scattering is considered. The inverse problem was solved by means of minimization of the residual functional with the help of the gradient descent method. The initial data were calculated with the help of the numerical method. On each step of the iterative method of minimization, the residual functional was calculated approximately with the help of the small slope method. The examples of the shape determination are considered. Author

N92-13972*# Scientific Research Associates, Inc., Glastonbury, CT.
OPTIMIZATION OF TRANSISTOR DESIGN INCLUDING LARGE SIGNAL DEVICE/CIRCUIT INTERACTIONS AT EXTREMELY HIGH FREQUENCIES (20-100+GHz) **c33**
Ralph Levy and H. L. Grubin *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 573-591 Sponsored in part by DARPA and NSF (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 09A

Transistor design for extremely high frequency applications requires consideration of the interaction between the device and the circuit to which it is connected. Traditional analytical transistor models are to approximate at some of these frequencies and may not account for variations of dopants and semiconductor materials (especially some of the newer materials) within the device. Physically based models of device performance are required. These are based on coupled systems of partial differential equations and typically require 20 minutes of Cray computer time for a single AC operating point. A technique is presented to extract parameters from a few partial differential equation solutions for the device to create a nonlinear equivalent circuit model which runs in approximately 1 second of personal computer time. This nonlinear equivalent circuit model accurately replicates the contact current properties of the device as computed by the partial differential solver on which it is based. Using the nonlinear equivalent circuit model of the device, optimization of systems design can be performed based on device/circuit interactions. Author

N92-13973*# Tsinghua Univ., Bejing (China). Dept. of Thermal Engineering.
DESIGN OF TRANSONIC COMPRESSOR CASCADES USING HODOGRAPH METHOD **c07**
Zuoyi Chen and Jingrong Guo *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 593-598 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

The use of the Hodograph Method in the design of a transonic

compressor cascade is discussed. The design of the flow mode in the transonic compressor cascade must be as follows: the flow in the nozzle part should be uniform and smooth; the location of the sonic line should be reasonable; and the aerodynamic character of the flow canal in the subsonic region should be met. The rate through cascade may be determined by the velocity distribution in the subsonic region (i.e., by the numerical solution of the Chaplygin equation). The supersonic sections A'C' and AD are determined by the analytical solution of the Mixed-Type Hodograph equation. Author

N92-13974*# Tsinghua Univ., Bejing (China).
THE RESEARCH PROGRESS ON HODOGRAPH METHOD OF AERODYNAMIC DESIGN AT TSINGHUA UNIVERSITY **c02**
Zuoyi Chen and Jingrong Guo *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 599-606 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

Progress in the use of the Hodograph method of aerodynamic design is discussed. It was found that there are some restricted conditions in the application of Hodograph design to transonic turbine and compressor cascades. The Hodograph method is suitable not only to the transonic turbine cascade but also to the transonic compressor cascade. The three dimensional Hodograph method will be developed after obtaining the basic equation for the three dimensional Hodograph method. As an example of the Hodograph method, the use of the method to design a transonic turbine and compressor cascade is discussed. Author

N92-13975# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
[ACTIVITIES OF THE UNIVERSITY OF TORONTO INSTITUTE FOR AEROSPACE STUDIES] Annual Progress Report, 1988-1989
1989 123 p
(CTN-91-60222) Avail: NTIS HC/MF A06

A description of the University of the Toronto Institute for Aerospace Studies (UTIAS) facility and program, and a report of progress in aerospace research is presented. Topics discussed include aeroacoustics, air cushion technology, combustion and propulsion, computational fluid dynamics, fiber optic smart structures, hypersonic aerodynamics, space robotics, and structural mechanics and materials science. For individual titles, see N92-13976 through N92-13989.

N92-13976# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
AEROACOUSTICS **c71**
G. W. Johnston, E. DellaPenna, S. Picket, M. Ohayon, M. Titcombe, and M. Langlois *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 52-53 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief review of aeroacoustical investigations currently taking place at the Institute for Aerospace Studies at the University of Toronto is provided. Several studies of the excitation of Tollmein Schlichting waves are underway. Excitation of the boundary layer was achieved by an acoustic field with a large variation in amplitude and phase. A significant axial gradient in the applied acoustic field, well downstream from the leading edge, was employed to excite the laminar layer. The variation in the acoustic field was located in the parallel flow region of the boundary layer. Hot wire anemometry was used to measure Tollmein Schlichting wave profiles and growth rates under conditions of natural growth and acoustic excitation. The results indicate that variations in the external acoustic field can excite Tollmein Schlichting waves. These waves then grow according to their natural growth rate as they travel downstream through the relatively uniform region of the external acoustic field. A study into the role of acoustic diffraction at a flat plate leading edge in the excitation of waves has been completed. An important finding is the requirement for a triple deck treatment in the unsteady boundary layer region upstream from the usual Tollmein Schlichting boundary layer region. CISTI

N92-13977# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
AERODYNAMICS **c07**
J. D. DeLaurier, G. W. Johnston, D. W. Zingg, W. D. McKinney, C. Hayball, G. Saarenvirta, J. D. Lowe, B. Woodcock, S. Hulshoff, and H. Murty et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 54-58 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief review of aerodynamic investigations currently underway at the Institute for Aerospace Studies is provided. An extensive investigation of airship dynamics and turbulence response has resulted in the development of a numerical analysis of airship dynamic stability and stochastic response. Research on the performance and detailed design of a remotely piloted microwave powered aircraft is underway. A 12-m span airframe is currently being constructed to assist in the development of an automatic flight control system. The aerodynamics of flapping wing flight are being studied to provide understanding of the energetics and efficiency of animal flight. A two phase program has been initiated to study finite amplitude response and flutter of two dimensional airfoils involving the computation of steady and unsteady transonic flows using nonlinear full potential equations. A number of studies of propeller aerodynamics are underway including: development of a generalized incompressible 3-D propeller analysis code; an experimental unsteady propeller loading study; application of modern computational methods to the work of Theodorsen on propeller efficiency; development of a 3-D undsteady Euler code to study propeller wing interaction at transonic speed; and investigation of the modified viscous boundary flow found on rotating propeller blades. Airfoil flow on trailing edges and on leading edge slat airfoil combinations are currently being studied. A research duct facility has been built to study the destruction of toxic hydrocarbon gases by irradiated ozone. Finally, an evaluation of various turbulence models for the computation of 3-D internal flows is in progress. CISTI

N92-13978# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
COMBUSTION AND PROPULSION **c25**
J. P. Sislian, Y. Sheng, L.-Y. Jiang, R. A. Cusworth, J. T. C. Hu, T. M. Atamanchuk, and R. Dudebout et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 65-67 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief review of combustion and propulsion research currently underway at the Institute for Aerospace Studies is provided. Afterburning rocket exhaust plume properties are being investigated both experimentally and by mathematical analysis. The objective is to compile detailed data on turbulence qualities in simulated rocket exhaust jet flows under cold and combusting conditions. Computational fluid dynamic methods and an argon-ion two dimensional laser Doppler velocimetery are being used in a detailed investigation of the turbulent flowfield inside a small helicopter engine combustor. The data will be used to evaluate combustor modelling computer codes and mathematical modelling of processes inside a combustor. The effects of heat addition by shock induced combustion of a fuel-air gas mixture to supersonic flows are being studied as part of a project on aerodynamic and propulsive characteristics of shocked combustion ramjets. An upwind algorithm based on Roe's scheme has been developed to solve planar and axisymmetric parabolized Navier Stokes equations. This computational method was used to assess the viscous aerodynamic characteristics of a triple shock inlet at Mach 8. The design of an axisymmetric hypersonic nozzle, including equilibrium real gas effects and boundary layer effects, has been studied with application to such effects as varying stagnation conditions in the tunnel, including nonequilibrium real gas effects. CISTI

N92-13979# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
COMPUTATIONAL FLUID DYNAMICS **c02**
D. W. Zingg, J. J. Gottlieb, G. W. Johnston, P. A. Sullivan, D. Bergeron, C. P. T. Groth, D. F. Hawken, H. Murty, T. Nelson, and C. Walsh et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 68-70 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A review is presented of University of Toronto Institute of Aerospace Studies theoretical research on computational techniques for the analysis of fluid dynamics problems. In a study of the limits of applicability of boundary-layer equations for transonic airfoil computations, a generalized form of these equations is solved on a fine grid near the airfoil. The solution is embedded into a coarse-grid Navier-Stokes solution, resulting in a very efficient computational method. A new procedure which avoids the need for iteration has been developed for interpolation on a structured, curvilinear, 2-dimensional grid. Euler computations of airfoil flows using the ARC2D codc have been compared with analytical solutions. A technique has been developed using Richardson extrapolation which improves the accuracy of numerical solutions to the Euler equations. A new exact Riemann solver has been invented for use in the random-choice method (RCM) for solving hyperbolic conservation laws in 1 space dimension. Studies are also being conducted on the actual convergence rate of the RCM. Two adaptive numerical methods of solving partial differential equations have been studied in depth. An axisymmetric model of tube collapse has been developed, coupled to a 1-dimensional fluid flow model, and applied to the study of tracheal collapse.
CISTI

N92-13980# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FIBER OPTIC SMART STRUCTURES **c74**
R. M. Measures, K. Liu, W. E. R. Davies, K. F. McEwen, N. D. Glossop, D. Laurin, R. Turner, T. Valis, B. Blagojevic, and S. Ferguson et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 71-75 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief review of research carried out at the Fiber Optic Smart Structure Laboratory at the Institute for Aerospace Studies is provided. The use of Michaelson fiber optic sensors embedded within composite structures as optical strain gauges has been tested, resulting in the development of a compact, rugged and relatively inexpensive Mach-Zehnder interferometric fiber optic sensor for measuring uniaxial strains or temperature changes with high sensitivity. A fiber optic strain rosette based on Michaelson fiber optic sensors has been developed and successfully tested. A polarimetric fiber optic strain sensor developed at the lab has relatively low sensitivity but should be useful when long sensor lengths are desired. A program is underway to develop a built-in damage assessment system for composite materials based on a grid of optical fibers embedded within the structure. A special treatment for optical fibers to enhance their sensitivity to damage has been developed and the optimal orientation and location of embedded fibers has been studied. An aircraft wing leading edge with a built-in optic damage assessment system has been fabricated for test purposes. The use of a fiber optic based system to detect acoustic energy released by delamination is being investigated. An imaging multiple arm position sensor system has been developed for monitoring the motion of five of the arms of the DAISY space emulator.
CISTI

N92-13981# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FLIGHT RESEARCH **c05**
J. H. deLeeuw and Tai Quach et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 76-77 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief review of flight research carried out at the University of Toronto Institute for Aerospace Studies (UTIAS) is provided. Work has continued on helicopter parameter estimation in collaboration with the Flight Research Laboratory or the National Aeronautical Establishment. Under the auspices of the Advisory Group for Aeronautical Research Development (AGARD) Working Group 18, this project is to analyze with UTIAS algorithms the flight test data for three helicopters: the BO-105, the Puma, and the Apache. Recent work has concentrated on parameter estimation in the context of 6 degrees of freedom, linear models, using the time domain methods of step-wise regression, and maximum likelihood estimation. Attention was also given to the determination of the subset of all parameters in the model that are significant in describing the helicopter response for the particular maneuvres of the flight tests. This was done by a series of verification analyses, where model parameters obtained from one experiment were used for predicting the response for an independent experiment. A study of the criteria for helicopter model selection was carried out, which examined whether the flight dynamics of conventional maneuvers can be successfully modelled by a 6 degree of freedom model without determining the complete set of stability and control derivatives.
CISTI

N92-13982# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FLIGHT SIMULATION **c09**
L. D. Reid, S. Advani, W. O. Graf, R. J. Soosaar, P. R. Grant, P. A. Robinson, D. M. Chisholm, A. Hoppe, J. Kirdeikis, and R. A. Romano et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 78-79 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A brief description is provided of several University of Toronto Institute for Aerospace Studies (UTIAS) programs designed to investigate human factors and system optimization involved in flight simulation. A program of study has been undertaken to determine the critical amplitudes required to provide sensations of motion in the flight simulator sickness that are congruent with the expected motion of an aircraft. An electrogastrogram system designed to measure stomach activity associated with simulator sickness has been developed and tested. A program to evaluate nonlinear motion drive algorithms for flight simulators has been completed. The modelling of atmospheric disturbances, especially atmospheric turbulence and wind gradients associated with thunderstorms, is under study. Implementation of software for Instrument Flight Rule (IFR) flight test evaluations of a Bell 205 Helicopter simulator developed earlier, is currently underway. A generic spin simulator for simulation of light aircraft flight when airframe spin data is unavailable has been implemented on the flight simulator. An expert system for the purpose of tuning motion drive algorithms is to be developed.
CISTI

N92-13983# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
HYPERSONIC AERODYNAMICS **c09**
P. A. Sullivan, J. P. Sislian, J. J. Gottlieb, S. Molder, D. F. Hawken, A. Short, H. Stassen (Ryerson Polytechnical Inst., Toronto, Ontario), R. L. Deschambault, J. Z. Shen, and Y. Sheng et al *In Its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 86-89 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

The refurbishment and commissioning of a hypersonic gun tunnel built in the 1960's, the collection of basic data, and the development of analytical methods at the University of Toronto Institute for Aerospace Studies (UTIAS) is described. Design improvements are underway to the gun piston employing modern numerical methods in fluid dynamics and stress analysis of high strength to weight materials. An advanced numerical simulation of the tunnel operation has been implemented involving gas flows in the driver, barrel, nozzle, and test section to that of the piston, and incorporating viscous and real-gas phenomena. The interactions of an oblique shock with a hypersonic boundary layer on a flat plate at concave and convex corners is being studied

numerically to supplement similar experimental research conducted in the hypersonic impulse tunnel. An experimental study of hypersonic flow development in a circular pipe at a flow Mach number of about 8 has been undertaken to provide data to guide the development of fluid dynamics codes applicable to hypersonic internal flows. Experimental measurements were made on three different hypersonic compressive flow geometries (a Prandtl-Meyer inlet, a Busemann inlet, and a Oswatitsch inlet) so as to compare their efficacy as scramjet inlets. A computer code has been developed to compute unsteady gas flows through and around model hypersonic inlets that are being tested in the hypersonic impulse tunnel. CISTI

N92-13984# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
MATERIALS PROCESSING IN SPACE **c29**
R. C. Tennyson, N. Salansky, W. D. Morison, and G. Fishbein et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 90-91 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Several programs are currently underway at the University of Toronto Institute for Aerospace Studies (UTIAS) in the area of materials processing in space, including: (1) the design and development of some hardware components for a NASA space-based molecular beam epitaxy facility for growing thin films; (2) a continued evolution of a multipurpose test bed, capable of supporting a range of demonstration experiments on NASA's KC-135 microgravity aircraft, designed to prepare a television program on microgravity science; (3) the development and testing of atomic oxygen, temperature, vacuum, and ultraviolet resistant thermal control materials and coatings for spacecraft applications; and (4) evaluation of material degradation of composite samples recovered from the Long Duration Exposure Facility. CISTI

N92-13985# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
NONSTATIONARY GASDYNAMICS **c34**
J. J. Gottlieb, C. P. T. Groth, R. J. Hawboldt, D. F. Hawken, G. D. Lock, C. H. Wong, Y. S. Chan, J. Maillette, G. L. Petrini, and J. S. Picket et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 93-95 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

A review is provided of nonstationary gas dynamic investigations carried out at the University of Toronto Institute for Aerospace Studies. Numerical studies aimed at predicting the operation and performance of two stage light-gas guns and selecting optimum gas operating conditions are ongoing. Preliminary internal ballistics work on modelling the motions of propellant gases and projectiles in an experimental gun with a high pressure combustion section and a low pressure launch tube has been completed. The study of propellant combustion in a closed vessel to obtain propellant burning rates and combustion gas properties for use in modelling of gas guns is now underway. The nonequilibrium structure of a shock front in a dusty gas is being studied in a dusty shock tube facility to determine particle drag and heat transfer coefficients. Studies undertaken to provide data for the design of a large air-blast and thermal simulation facility include: investigation of the reflection eliminator, the venting from the test section of combustion products from thermal radiation sources, and the prediction of unsteady flow. A high pressure reservoir with an exit nozzle containing a slot has been constructed to obtain experimental data on discharge coefficients of orifices and slots in high-low pressure guns and on blast simulators. CISTI

N92-13986# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SHOCK WAVES, IMPLOSIONS AND DUSTY GASES **c34**
I. I. Glass, D.-L. Zhang, and J. Kaca et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 96-97 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Progress in analytical, numerical, and experimental research on shock waves, implosions, and dusty gases at the University of Toronto Institute for Aerospace Studies is reviewed. Solutions for the laminar compressible dusty-gas boundary layer over a semi-infinite flat plate were obtained, as well as that for the complementary boundary layer induced by a moving shock in a dusty-gas tube. Numerical studies of weak spherical N-waves in air are continuing. Research on the effects of shock-wave compression from implosions on chemical reaction and diffusion rates in solids is completed, as is analytical and experimental study of pseudo-stationary oblique shock wave reflections. CISTI

N92-13987# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SPACE ROBOTICS **c63**
G. M. T. DEleuterio, P. C. Hughes, G. B. Sincarsin, V. Pugliese, T. Cherpillod, J. Carusone, D. P. W. Graham, F. Naccarato, C. Sallaberger, and I. Sharf et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 98-100 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Progress in space robotics research at the University of Toronto Institute for Aerospace Studies is reviewed. Development of simulation procedures utilizing the capabilities of parallel processors is underway. Kinematic strategies to handle the large number of degrees of freedom intrinsic to variable geometry truss manipulator arms are being investigated. The use of artificial intelligence techniques and especially of neural networks to control manipulator operation is being studied. One method called MOVE (Manipulator Operation using Value Encoding) based on coarse coding techniques has been developed. The phenomenon of model localization which can result from slight perturbations in a nominally ordered system is also under investigation. CISTI

N92-13988# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SPACECRAFT DYNAMICS AND CONTROL **c18**
P. C. Hughes, G. M. T. DEleuterio, G. B. Sincarsin, V. Pugliese, T. Cherpillod, K. A. Carroll, D. J. McTavish, C. J. Damaren, G. W. Crocker, and T. Hong et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 101-102 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Progress in the study of spacecraft dynamics and control at the University of Toronto Institute for Aerospace Studies is reviewed. An upgrade to the Daisy Research Facility, designed to investigate control of flexible spacecraft, is underway. A multibus II real-time computer system, new reaction wheel controllers, and power amplifiers are being integrated into Daisy. The GHM (Golla, Hughes, McTavish) theory, a complete procedure for incorporating viscoelastic material properties into structural finite elements, is complete. This representation of material behavior provides a more realistic model of damping characteristics than current models and retains the matrix second order form of the equations of motion. Viscoelastic modulus data have been measured for use in a GHM finite element model of a truss structure. A study on the control of large space structures using a distribution of gyricity is complete. The resulting control systems are very successful in suppressing structural vibration. An analytical examination of the adverse effects of time delays introduced by a computer on the control of flexible space structures has been undertaken. Work aimed at reducing the order of both the structural model and the control system when controlling flexible structures is continuing. A technique has been developed in which balanced Grammian matrices provide the basis for deleting certain state variables associated with the controller. CISTI

N92-13989# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
STRUCTURAL MECHANICS AND MATERIALS SCIENCE **c99**
R. C. Tennyson, J. S. Hansen, W. G. Elliott, W. J. Unger, B.

Blagojevic, M. G. Blum, R. C. Bowser, T. H. Braithwaite, P. G. Cameron, and T. L. C. Chen et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 103-105 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Progress in structural mechanics and materials science research programs at the University of Toronto Institute for Aerospace Studies is reviewed. Two major research programs are underway in the study of composite materials. The first program involves the study of fatigue life of fiber matrix thermoplastic laminates, tailoring residual stress distribution in these materials through selective local melting, and fiber composite repair using external heating. In the second program, experiments are underway to evaluate the capabilities of embedded fiber optic sensors to respond to thermomechanical loading of composite laminates. Four space simulators have been assembled which provide the capability of studying in-situ the effect of thermal-vacuum cycling, ultraviolet radiation, electron bombardment, and atomic oxygen on the mechanical, thermal, and physical properties of polymer matrix composites and thin films. Analytical and experimental projects are underway dealing with viscoelastic characteristics of reinforced fiber composites including: high strain load analysis, mathematical treatment of damping on large space structures, failure prediction, and determination of residual strength in damaged systems. Finite element strategies are being developed for viscoelastic damping of large space structures, prediction of failure of composite structures, analysis of composite systems subject to large strain loading, determination of the residual strength of damaged composite systems, and the modeling of damage to composite laminates subject to low energy impact. CISTI

N92-13990# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
CHINA AVIATION JOURNAL (SELECTED ARTICLE)
18 Jul. 1991 14 p Transl. into ENGLISH from Xiandai Minhand (China), v. 3, no. 2, Mar. 1989 p 20-21
(AD-A240985; FTD-ID(RS)T-0291-91) Avail: NTIS HC/MF A03 CSCL 01/3

This translation of the Chinese journal, International Aviation, contains two articles. The first article is a description of the modernization of the Y5B. The Y5B is a multipurpose aircraft, with and emphasis on agricultural applications. The second article discusses five MD-82's in service with Shianghai Eastern Airlines and ShenYang Civil Aviation Services. GRA

N92-13991# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
INTERNATIONAL AVIATION (SELECTED ARTICLE)
25 Jul. 1991 19 p Transl. into ENGLISH from Guoji Hangkong (China), no. 3, 49-51, 1990 p 42
(AD-A240986; FTD-ID(RS)T-0167-91) Avail: NTIS HC/MF A03 CSCL 01/3

A discussion of China's role in the future of commercial and military aircraft manufacturing is presented. The discussion is given in two parts. The first part describes the relative advantages of delta wing aircraft. The second part gives a description of the state of aircraft manufacturing in the West (United States, United Kingdom, France, and Germany) and then goes on to discuss the need for modernization in China's aircraft industry. GRA

N92-13992# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
INTERNATIONAL AVIATION (SELECTED ARTICLE)
18 Jul. 1991 22 p Transl. into ENGLISH from Guoji Hangkong (China), no. 10, 49 1989 p 34-36
(AD-A240987; FTD-ID(RS)T-0170-91) Avail: NTIS HC/MF A03 CSCL 21/5

This translation of the Chinese journal, International Aviation, contains two articles. The first article is a discussion of the development of China's first generation augmented turbofan, the WS6. The second article is a description of China's first-generation full-pressure helmet, the TK-4. GRA

N92-13993# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
INTERNATIONAL AVIATION (SELECTED ARTICLES)
11 Sep. 1991 53 p Transl. into ENGLISH from Guoji Hangkong (China), no. 8, 1990 p 8-17
(AD-A241119; FTD-ID(RS)T-0461-91) Avail: NTIS HC/MF A04 CSCL 01/3

The results of ten years of Chinese research on aircraft aeroelastics are presented. The subjects discussed are: the development of the computer study of aerodynamics and wind tunnel testing technology, aerodynamic research by the Beijing Aerodynamic Institute, research on complex flows by the Institute of Fluid Mechanics of the Beijing University of Aeronautics and Astronautics,and a type of new model exciter system used in research on aircraft chatter. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-13994 Duke Univ., Durham, NC.
ANALYTICAL/NUMERICAL MATCHING AND PERIODIC INVERSION: TWO ADVANCES IN FREE WAKE ANALYSIS Ph.D. Thesis
Wayne Owen Miller 1990 211 p
Avail: Univ. Microfilms Order No. DA9122430

Free wake methods are used for the analysis of potential fluid dynamics with embedded vorticity. The vorticity convects with the fluid and induces a velocity field defined by the Biot-Savart law. Free wake methods define vortex dynamics and the induced velocity field by discretizing the vorticity into elements and following their convection. The application of interest to this research was rotorcraft wakes. The scope of the research was wakes that can be modeled by vortex filaments with finite cores, which are used alone to model vortex tubes, or in groups to model vortex sheets. Vortex filaments are discretized into elements which are simple curves that are fit to the filament. This research used the vortex particle, which is the lowest order and most efficient element, but it is only accurate at a distance from the filament. The accuracies of higher order elements were also compared. Analytical/Numerical Matching is a free wake method which improves computational efficiency without compromising accuracy. A wake of N vortex elements requires O (N exp 2) element evaluations, but only O (N) elements are in the near field of a filament. The ANM method uses vortex particles to efficiently generate a solution which is accurate in the far field. The near field is resolved by superimposing an analytical correction. The method is four times faster than previous methods, and an order of magnitude gain is possible. The method was linearized to improve efficiency and open new analysis options. Periodic Inversion is a solution method for rotor wakes in steady flight which enforces their ideal periodic behavior. Periodic Inversion is not a time marching method, and therefore avoids poor convergence behavior at low advance ratios. A unique set of periodic variables was developed for the method, and the resulting problem is in the form of a linear system which is iteratively solved for corrections to a full period of wake. The method was used to study wakes in hover and at low speeds, where free wake solutions have not previously been obtained. The method should allow coupling with panel methods and blade dynamics, and allow for stability analysis of the wake. Dissert. Abstr.

N92-13995*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
DEFINITION OF THE UNSTEADY VORTEX FLOW OVER A WING/BODY CONFIGURATION Final Technical Report, 21 May - 20 Nov. 1991
S. G. Liou, B. deBry, J. Lenakos, J. Caplin, and N. M. Komerath 20 Nov. 1991 131 p

(Grant NAG1-1278)
(NASA-CR-180083; NAS 1.26:180083; GITAER-91-6) Avail: NTIS HC/MF A07 CSCL 01A

A problem of current interest in computational aerodynamics is the prediction of unsteady vortex flows over aircraft at high angles of attack. A six-month experimental effort was conducted at the John H. Harper Wind Tunnel to acquire qualitative and quantitative information on the unsteady vortex flow over a generic wing-body configuration at high angles of attack. A double-delta flat-plate wing with beveled edges was combined with a slender sharp-nosed body-of-revolution fuselage to form the generic configuration. This configuration produces a strong attached leading edge vortex on the wing, as well as sharply-peaked flow velocity spectra above the wing. While it thus produces flows with several well-defined features of current interest, the model was designed for efficiency of representation in computational codes. A moderate number of surface pressure ports and two unsteady pressure sensors were used to study the pressure distribution over the wing and body surface at high angles of attack; the unsteady pressure sensing did not succeed because of inadequate signal-to-noise ratio. A pulsed copper vapor laser sheet was used to visualize the vortex flow over the model, and vortex trajectories, burst locations, mutual induction of vortex systems from the forebody, strake, and wing, were quantified. Laser Doppler velocimetry was used to quantify all 3 components of the time-average velocity in 3 data planes perpendicular to the freestream direction. Statistics of the instantaneous velocity were used to study intermittency and fluctuation intensity. Hot-film anemometry was used to study the fluctuation energy content in the velocity field, and the spectra of these fluctuations. In addition, a successful attempt was made to measure velocity spectra, component by component, using laser velocimetry, and these were compared with spectra measured by hot-film anemometry at several locations. Author

N92-13996*# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
THE EFFECTS OF WINGLETS ON LOW ASPECT RATIO WINGS AT SUPERSONIC MACH NUMBERS M.S. Thesis Report Feb. 1989 - Apr. 1991
James A. Keenan and John M. Kuhlman Washington NASA. Langley Research Center Nov. 1991 347 p
(Grant NAG1-951)
(NASA-CR-4407; NAS 1.26:4407) Avail: NTIS HC/MF A15 CSCL 01A

A computational study was conducted on two wings, of aspect ratios 1.244 and 1.865, each having 65 degree leading edge sweep angles, to determine the effects of nonplanar winglets at supersonic Mach numbers. A Mach number of 1.62 was selected as the design value. The winglets studied were parametrically varied in alignment, length, sweep, camber, thickness, and dihedral angle to determine which geometry had the best predicted performance. For the computational analysis, an available Euler marching technique was used. The results indicated that the possibility existed for wing-winglet geometries to equal the performance of wing-alone bodies in supersonic flows with both bodies having the same semispan. The first wing with winglet used NACA 1402 airfoils for the base wing and was shown to have lift-to-pressure drag ratios within 0.136 percent to 0.360 percent of the NACA 1402 wing-alone. The other base wing was a natural flow wing which was previously designed specifically for a Mach number of 1.62. The results obtained showed that the natural wing-alone had a slightly higher lift-to-pressure drag than the natural wing with winglets. Author

N92-13997*# Titan Systems, Inc., Princeton, NJ. A.R.A.P. Group.
A UNIFIED VISCOUS THEORY OF LIFT AND DRAG OF 2-D THIN AIRFOILS AND 3-D THIN WINGS
John E. Yates Washington NASA. Langley Dec. 1991 96 p
(NASA Order L-74809-C)
(NASA-CR-4414; NAS 1.26:4414) Avail: NTIS HC/MF A05 CSCL 01A

A unified viscous theory of 2-D thin airfoils and 3-D thin wings is developed with numerical examples. The viscous theory of the load distribution is unique and tends to the classical inviscid result with Kutta condition in the high Reynolds number limit. A new theory of 2-D section induced drag is introduced with specific applications to three cases of interest: (1) constant angle of attack; (2) parabolic camber; and (3) a flapped airfoil. The first case is also extended to a profiled leading edge foil. The well-known drag due to absence of leading edge suction is derived from the viscous theory. It is independent of Reynolds number for zero thickness and varies inversely with the square root of the Reynolds number based on the leading edge radius for profiled sections. The role of turbulence in the section induced drag problem is discussed. A theory of minimum section induced drag is derived and applied. For low Reynolds number the minimum drag load tends to the constant angle of attack solution and for high Reynolds number to an approximation of the parabolic camber solution. The parabolic camber section induced drag is about 4 percent greater than the ideal minimum at high Reynolds number. Two new concepts, the viscous induced drag angle and the viscous induced separation potential are introduced. The separation potential is calculated for three 2-D cases and for a 3-D rectangular wing. The potential is calculated with input from a standard doublet lattice wing code without recourse to any boundary layer calculations. Separation is indicated in regions where it is observed experimentally. The classical induced drag is recovered in the 3-D high Reynolds number limit with an additional contribution that is Reynold number dependent. The 3-D viscous theory of minimum induced drag yields an equation for the optimal spanwise and chordwise load distribution. The design of optimal wing tip planforms and camber distributions is possible with the viscous 3-D wing theory. Author

N92-13998*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A STUDY ON VORTEX FLOW CONTROL ON INLET DISTORTION IN THE RE-ENGINED 727-100 CENTER INLET DUCT USING COMPUTATIONAL FLUID DYNAMICS
Bernhard H. Anderson, Pao S. Huang, William A. Paschal, and Enrico Cavatorta (Dee-Howard Co., San Antonio, TX.) 1992 13 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(NASA-TM-105321; E-6679; NAS 1.15:105321; AIAA-92-0152)
Avail: NTIS HC/MF A03 CSCL 01A

Computational fluid dynamics was used to investigate the management of inlet distortion by the introduction of discrete vorticity sources at selected locations in the inlet for the purpose of controlling secondary flow. These sources of vorticity were introduced by means of vortex generators. A series of design observations were made concerning the importance of various vortex generator design parameters in minimizing engine face circumferential distortion. The study showed that vortex strength, generator scale, and secondary flow field structure have a complicated and interrelated influence on the engine face distortion, over and above the initial geometry and arrangement of the generators. The installed vortex generator performance was found to be a function of three categories of variables: the inflow conditions, the aerodynamic characteristics associated with the inlet duct, and the design parameters related to the geometry, arrangement, and placement of the vortex generators within the outlet duct itself. Author

N92-13999*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
ANALYSIS AND DESIGN OF PLANAR AND NON-PLANAR WINGS FOR INDUCED DRAG MINIMIZATION Annual Progress Report
K. Mortara, Dennis M. Straussfogel, and Mark D. Maughmer Dec. 1991 56 p
(Grant NAG1-1198)
(NASA-CR-189509; NAS 1.26:189509) Avail: NTIS HC/MF A04 CSCL 01A

The goal of the work was to develop and validate computational tools to be used for the design of planar and non-planar wing

geometries for minimum induced drag. Because of the iterative nature of the design problem, it is important that, in addition to being sufficiently accurate for the problem at hand, they are reasonably fast and computationally efficient. Toward this end, a method of predicting induced drag in the presence of a non-rigid wake is coupled with a panel method. The induced drag prediction technique is based on the Kutta-Joukowski law applied at the trailing edge. Until recently, the use of this method has not been fully explored and pressure integration and Trefftz-plane calculations favored. As is shown in this report, however, the Kutta-Joukowski method is able to give better results for a given amount of effort than the more common techniques, particularly when relaxed wakes and non-planar wing geometries are considered. Using these tools, a workable design method is in place which takes into account relaxed wakes and non-planar wing geometries. It is recommended that this method be used to design a wind-tunnel experiment to verify the predicted aerodynamic benefits of non-planar wing geometries. Author

N92-14000*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SCREECH NOISE SOURCE STRUCTURE OF A SUPERSONIC RECTANGULAR JET

E. J. Rice and R. Taghavi (Sverdrup Technology, Inc., Brook Park, OH.) 1992 16 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA

(Contract NAS3-25266)

(NASA-TM-105384; E-6744; NAS 1.15:105384; AIAA-92-0503)

Avail: NTIS HC/MF A03 CSCL 01A

The near-field of the screech noise source structure of an under-expanded supersonic rectangular jet was studied in detail. A miniature probe microphone was used along with a reference microphone to determine the amplitude and phase of the sound pressure near and in the high speed flow field. The transverse structure of the unsteady pressure field was investigated by moving the probe microphone sufficiently far into the jet so that pressure fall-off was observed. Five islands of high sound pressure level have been distinguished which may be associated with the actual local sources of sound production. These sources of screech noise are closely associated with the jet shock structure as would be expected, with the peak region of noise level being found slightly downstream of each of the five observed shocks. The third and fourth noise sources have the highest levels and are about equal in strength. All of the apparent noise sources have their peak levels in the subsonic flow region. Strong cancellations in the acoustic field are observed in the downstream and sideline directions which may account for the predominant upstream propagation of the fundamental tone noise. Author

N92-14001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

LEWICE/E: AN EULER BASED ICE ACCRETION CODE

Mark G. Potapczuk 1992 25 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA

(NASA-TM-105389; E-6778; NAS 1.15:105389; AIAA-92-0037)

Avail: NTIS HC/MF A03 CSCL 01A

A new version of the LEWICE ice accretion computer code was developed which calculates the ice growth on two dimensional surfaces, incorporating the effects of compressibility through the solution of the Euler equations. The code is modular and contains separate stand-alone program elements that create a grid, calculate the flow field parameters, calculate the droplet trajectory paths, determine the amount of ice growth, and plot results. This code increases the applicability of ice accretion predictions by allowing calculations at higher Mach numbers. The new elements of the code are described. Calculated results are compared to experiment for several cases, including a LEWICE example case and a thin airfoil section at a Mach number of 0.58. Author

N92-14002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ANALYSIS OF AN ADVANCED DUCTED PROPELLER SUBSONIC INLET

Chanthy Iek, Donald R. Boldman, and Mounir Ibrahim (Cleveland State Univ., OH.) 1992 18 p Proposed for presentation at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA

(NASA-TM-105393; E-6784; NAS 1.15:105393; AIAA-92-0274)

Avail: NTIS HC/MF A03 CSCL 01A

A time marching Navier-Stokes code called PARC (PARC2D for 2-D/axisymmetric and PARC3D for 3-D flow simulations) was validated for an advanced ducted propeller (ADP) subsonic inlet. The code validation for an advanced ducted propeller (ADP) subsonic inlet. The code validation was implemented for a non-separated flow condition associated with the inlet operating at angles-of-attack of 0 and 25 degrees. The inlet test data were obtained in the 9 x 15 ft Low Speed Wind Tunnel at NASA Lewis Research Center as part of a cooperative study with Pratt and Whitney. The experimental study focused on the ADP inlet performance for take-off and approach conditions. The inlet was tested at a free stream Mach number of 0.2, at angles-of-attack between O and 35 degrees, and at a maximum propeller speed of 12,000 RPM which induced a corrected air flow rate of about 46 lb/sec based on standard day conditions. The computational grid and flow boundary conditions (BC) were based on the actual inlet geometry and the funnel flow conditions. At the propeller face, two types of BC's were applied: a mass flow BC and a fixed flow properties BC. The fixed flow properties BC was based on a combination of data obtained from the experiment and calculations using a potential flow code. Comparison of the computational results with the test data indicates that the PARC code with the propeller face fixed flow properties BC provided a better prediction of the inlet surface static pressures than the predictions when the mass flow BC was used. For an angle-of-attack of 0 degrees, the PARC2D code with the propeller face mass flow BC provided a good prediction of inlet static pressures except in the region of high pressure gradient. With the propeller face fixed flow properties BC, the PARC2D code provided a good prediction of the inlet static pressures. For an angle-of-attack of 25 degrees with the mass flow BC, the PARC3D code predicted statis pressures which deviated significantly from the test data; however, with the fixed flow properties BC, a good comparison with the test data was obtained. Author

N92-14003*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ON THE MECHANISM OF TURBULENCE SUPPRESSION IN FREE SHEAR FLOWS UNDER ACOUSTIC EXCITATION

K. B. M. Q. Zaman and E. J. Rice 1992 13 p Proposed for presentation at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992: sponsored by AIAA

(NASA-TM-105360; E-6739; AIAA-92-0065) Avail: NTIS HC/MF A03 CSCL 01A

Acoustic excitation at certain high frequencies has been known to suppress large amplitude fluctuations otherwise occurring naturally in various free shear flows. The phenomenon has been observed in flows with initially laminar or transitional boundary layers. An experimental investigation is conducted to consider two possibilities in regards to the mechanism of the effect. (1) The natural shear layer is self excited by the instability waves already developed in the upstream boundary layer. This is overridden when the shear layer is excited at its maximally unstable mode, causing the observed decrease in the intensities downstream. (2) The upstream boundary layer is in a transitional or buffeted laminar state, characterized by large amplitude unsteady fluctuations, which force the large fluctuations downstream. Excitation trips the upstream boundary layer to full turbulence, reduces the unsteady fluctuations, and thus causes the observed suppression of the intensities throughout the flowfield. The present experimental results refute either of these possibilities to be the general mechanism of the effect. Author

N92-14004# Technische Univ., Delft (Netherlands). Low Speed Aerodynamics Lab.
LDA MEASUREMENTS IN THE HIGHLY ASYMMETRIC TRAILING EDGE FLOW OF AN NLR 7702 AIRFOIL
L. H. J. Absil and D. M. Passchier Dec. 1990 26 p Sponsored in part by NLR, Amsterdam, Netherlands
(LR-646; ETN-92-90416) Avail: NTIS HC/MF A03

Results of detailed LDA (Laser Doppler Anemometry) measurements performed in the vicinity of the trailing edge of a supercritical NLR 7702 airfoil are presented. The two dimensional model, put at an angle of attack of 4 degrees, was tested at a Mach number of 0.1 and a Reynolds number of 1,500,000. Under these conditions the upper surface boundary layer is close to separation at the trailing edge. Downstream of the trailing edge, both shear layers merge together into a strongly curved, highly asymmetric near wake. In the boundary layers and in the near wake, distributions of the longitudinal and transverse mean velocity, turbulence normal and shear stresses, Skewness and Kurtosis factors were measured. The main objective of this investigation was to provide detailed and reliable mean velocity and turbulence data for development of turbulence closure models for trailing edge flows and validation of computational methods. ESA

N92-13951*# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.). Dept. of Aerodynamics.
APPLICATION OF DIRECT INVERSE ANALOGY METHOD (DIVA) AND VISCOUS DESIGN OPTIMIZATION TECHNIQUES
E. Greff, D. Forbrich, and H. Schwarten *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 307-324 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13953*# Shanghai Inst. of Mechanical Engineering (China). Lab. of Turbomachinery Aerodynamics.
VARIATIONAL FORMULATION OF HYBRID PROBLEMS FOR FULLY 3-D TRANSONIC FLOW WITH SHOCKS IN ROTOR
Gao-Lian Liu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 337-346 Sponsored in part by the National Natural Science Foundation, Peoples Republic of China (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13960*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
AIRFOIL OPTIMIZATION WITH EFFICIENT GRADIENT CALCULATIONS
Thomas Sorensen *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 433-444 Sponsored in part by MIT and NSF (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20N

N92-13961*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
DESIGN OPTIMIZATION OF TRANSONIC AIRFOILS
C.-Y. Joh, B. Grossman, and R. T. Haftka *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 445-456 (For primary document see N92-13928 05-01)
(Grant NSF DMC-86-15336)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13968*# Xian Jiaotong Univ. (China). Dept. of Power Mach. Eng.
A NEW METHOD OF OPTIMAL DESIGN FOR A TWO-DIMENSIONAL DIFFUSER BY USING DYNAMIC PROGRAMMING
Chuangang Gu, Moujin Zhang, Xi Chen, and Yongmiao Miao *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 531-540 (For primary document see N92-13928 05-01)
(Contract NSFC-C-59076261)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13969*# Beijing Univ. (China). Inst. of Fluid Mechanics.
AN INVERSE METHOD WITH REGULARITY CONDITION FOR TRANSONIC AIRFOIL DESIGN
Ziqiang Zhu, Zhixun Xia, and Liyi Wu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 541-552 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13970*# Xian Jiaotong Univ. (China).
STUDY OF A NEW AIRFOIL USED IN REVERSIBLE AXIAL FANS
Chaojun Li, Baosuo Wei, and Chuangang Gu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 553-562 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13974*# Tsinghua Univ., Bejing (China).
THE RESEARCH PROGRESS ON HODOGRAPH METHOD OF AERODYNAMIC DESIGN AT TSINGHUA UNIVERSITY
Zuoyi Chen and Jingrong Guo *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 599-606 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01A

N92-13979# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
COMPUTATIONAL FLUID DYNAMICS
D. W. Zingg, J. J. Gottlieb, G. W. Johnston, P. A. Sullivan, D. Bergeron, C. P. T. Groth, D. F. Hawken, H. Murty, T. Nelson, and C. Walsh et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 68-70 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-14084*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INCREASED EPHEMERIS ACCURACY USING ATTITUDE-DEPENDENT AERODYNAMIC FORCE COEFFICIENTS FOR INERTIALLY STABILIZED SPACECRAFT
David C. Folta and David F. Baker *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 249-264 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-14005# Federal Aviation Administration, Washington, DC. Office of Aviation Policy and Plans.
TERMINAL AREA FORECASTS: FY 1991-2005
Jul. 1991 544 p
(AD-A241489; FAA-APO-91-5) Avail: NTIS HC/MF A23 CSCL 01/2

This report contains forecasts of aviation activity of 866 airports in the United States for fiscal years 1991-2005. These include 399 airports with FAA air traffic control towers and radar approach control service and 25 FAA contract towers. For each airport,

detailed forecasts are made for the four major users of the air traffic system: air carriers, air taxi/commuters, general aviation, and military. Summary tables contain national, FAA regional, and State aviation data and other airport specific highlights. The forecasts have been prepared to meet the budget and planning needs of the FAA and to provide airport-specific information that can be used by State and local aviation authorities, the aviation industry, and the general public. GRA

N92-14006# National Transportation Safety Board, Washington, DC.
AIRCRAFT ACCIDENT REPORT: NORTHWEST AIRLINES, INC., FLIGHTS 1482 AND 299. RUNWAY INCURSION AND COLLISION, DETROIT METROPOLITAN/WAYNE COUNTY AIRPORT, ROMULUS, MICHIGAN, DECEMBER 3, 1990
25 Jun. 1991 178 p
(PB91-910405; NTSB/AAR-91/05; REPT-5416-B) Avail: NTIS HC/MF A09 CSCL 01C

The runway collision of two Northwest Airlines aircraft is examined on a runway at the Detroit Metropolitan/Wayne County Airport, Romulus, MI, on 3 Dec. 1990. The safety issues discussed are airport marking and lighting, cockpit resource management, air traffic control procedures in low visibility conditions, flight attendant procedures during evacuation; and design of the DC-9 tailcone emergency release system. Safety recommendations concerning these issues were made to the FAA, the Detroit Metropolitan/Wayne County Airport, and Northwest Airlines, Inc. Author

N92-14007# Royal Aerospace Establishment, Farnborough (England). Aerospace Div.
LIGHTNING PROTECTION REQUIREMENTS FOR AIRCRAFT: A PROPOSED SPECIFICATION
G. A. M. Odam, A. W. Hanson, and R. H. Evans 16 May 1991 50 p Revised
(RAE-TM-FS(F)-632-Rev-Issue-1; BR303122; ETN-92-90319)
Copyright Avail: NTIS HC/MF A03

The RAE/FS8 recommendation for a specification to define United Kingdom Ministry of Defence requirements for the lightning protection of aircraft is presented. The following are covered: background and advisory material, certification, design and testing requirements. ESA

N92-14008# Southwest Research Inst., San Antonio, TX.
PHYSIOLOGICAL RESPONSE OF BIRDS TO APPROACHING AIRCRAFT Final Report
S. Tomlinson, J. Buckingham, R. Erwin, B. Carpenter, and S. Wilhoite Oct. 1991 101 p
(Contract DTFA03-88-C-00041)
(DOT/FAA/CT-91/14) Avail: NTIS HC/MF A06

The physiological response (heart rate) of captive wild birds to approaching aircraft during the takeoff roll was determined. Methods and materials designed during the laboratory study were used during the field test to collect data on birds exposed to standard body and wide body aircraft during regularly scheduled departures from San Antonio International Airport. It was found that birds respond to wide body aircraft more than to standard body aircraft while viewing the aircraft during the takeoff roll. The feral pigeons were more responsive to the sight and sound of the approaching aircraft when compared to sound only. The gulls response was similar between sight and sound and sound only. Author

N92-14032# Array Systems Computing, Inc., Downsview (Ontario).
AUTOMATED BAGGAGE THREAT DETECTION
Thomas E. Feather, Adrian Lee-Kwen, Ling Guan, Stuart J. Berkowitz, and Maurice Audette (Transportation Development Centre, Montreal, Quebec) *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 135-138 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-14009 Communications Gillies, Inc., Sainte Lambert (Quebec).
ELECTRONIC SYSTEMS IN TRANSPORTATION
Micha Avni, ed. (Transport Canada Aviation, Ottawa, Ontario) Montreal, Quebec Transport Canada Sep. 1989 133 p Canadian Conference on Electrical and Computer Engineering held in Montreal, Ontario, 17-20 Sep. 1989
(CNT Proj. 6902)
(TP-9983; CTN-91-60231) Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Papers relating to electronic systems are given. Major topics include descriptions of work carried out under the auspices of Transport Canada's Transport Development Center, research into microwave landing systems, the use of electronic distance measuring equipment in automated aircraft control and landing, automated airport runway management, the use of electronic systems in search and rescue missions, airspace management systems, baggage inspection systems, and information systems development for marine, road, and rail transport. For individual titles, see N92-14010 through N92-14032.

N92-14010# Transportation Development Centre, Montreal (Quebec).
TDC: INNOVATION IN TRANSPORT **c85**
N. E. Rudback *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 2-4 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The Transportation Development Center (TDC) manages Transport Canada's core research and development (R&D) program. The mission of the TDC program is to apply science and technology to develop safer, more efficient, and effective transportation systems in Canada. The program addresses all modes of transport with R&D work being contracted out to the private sector. This paper outlines the scope of the R&D program and the methods used in defining, implementing, and managing the R&D program. About 24 percent of the 14.5 million dollar research budget is directed at air transport, compared to 28 percent for marine transport, 14 percent for highway, and 10 percent for rail transport. CISTI

N92-14011# Canadian Astronautics Ltd., Ottawa (Ontario).
GUIDANCE ANGLE MEASUREMENT OF AN MLS ANTENNA
S. Radhakant, B. C. Blevis, R. Ulan, and M. Z. El-Gamal (Transport Canada Aviation, Ottawa, Ontario) *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 6-9 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Methods and equipment to test, certify, and commission microwave landing systems (MLS) are required before their widespread introduction into airports. Described here is the development of a reliable and versatile test set for measuring the accuracy of the time reference scanning beam on the MLS transmitting system. An effort is made to separate the errors introduced by the measuring system from those generated by the antenna and transmitting equipment. The equipment consists of: (1) a signal analyzer which computes the guidance angle using the log video output of a standard MLS receiver, (2) a guidance angle simulator, (3) the antenna under test mounted on a controllable turntable, and (4) a receiving antenna mounted on a

tower. This equipment was located in a test range which was designed to reduce extraneous factors such as multipath effects. The accuracy to which various range measurements should be made has been investigated. Measurements on an azimuth antenna of the effect of beam skewing on the guidance angle exhibited an error of as much as 0.1 deg at a guidance angle of 50 deg. The error in the guidance angle measurement due to conical scan was found to be as large as 2 deg at a guidance angle of 50 deg and an elevation of 15 deg. It was found that the equipment could make accurate guidance angle measurements at small angles. Accurate guidance angle measurements at large angles requires the minimization of these errors by range calibration, and modification of the guidance angle measurement algorithm.

CISTI

N92-14012# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).

IMAGE-SUPPORTED NAVIGATION FOR TESTING INSTRUMENT LANDING SYSTEMS

U. Brokof and F. Knabe *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 10-13 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The testing of instrument landing systems (ILS) at airports is constrained by requirements of the International Civil Aviation Organization (ICAO) as well as safety and economic considerations. A new test system developed by the Cooperative Flight Measurement Systems Group of the German Aerospace Research Establishment is described. Basic navigation is done by an inertial navigation system. Multiple distance measuring equipment is incorporated to improve en route navigation. A video system connected to an image processor uses runway threshold markings to update position information to a high degree of accuracy during the approach. The system works without ground staff or special installations. Computation of calibration data is accomplished in flight following the approach. Simulations and flight tests indicate that the required accuracy for ICAO category III flights can be achieved with two video measurements at both ends of the runway. Three dimensional position data are computed continuously allowing approaches at different angles and curved approaches. The system is ready for test with microwave landing systems.

CISTI

N92-14013# Minority Services, Inc., Washington, DC.

COMPREHENSIVE MLS TESTING FOR CATEGORY 1, 2, AND 3 OPERATION

Alex E. Smith *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 14-17 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper reviews the test requirements required to insure than an installed microwave landing system (MLS) will meet all the exacting requirements to provide for International Civil Aviation Organization (ICAO) category I, II, and III operations. General requirements of MLS testing are presented, and testing is considered throughout the entire life cycle of the equipment, from design to service. The top down process of specifying requirements and designing to requirements is applied to system testing. A summary of the formal review process carried out by the U.S. military and the Federal Aviation Administration to test for electronic equipment quality assurance is provided to illustrate the role of testing in the design process. A summary of an MLS service life testing program at various stages is provided including: factory production testing, initial ground testing, and flight testing. Testing can be done from the bottom up to ensure that all requirements are met. For MLS most testing is performed at the factory and on the ground. In large countries with long distances between airports, such as Canada, more tests are performed in flight. Flight inspection is the final verification that the system is performing properly in its operating environment. CISTI

N92-14014# Transport Canada Aviation, Ottawa (Ontario).

THE EFFECT OF ERROR TOLERANCES ON MLS ARRAY ANTENNA

M. Z. El-Gamal and C. Bowman *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 18-21 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

A linear microwave landing system (MLS) antenna array was modelled and tolerance tests on positioning, amplitude and phase, and element failures were simulated to determine its effects on the pointing error, sidelobe levels and beam width. The pointing errors were found to be dependent on the phase errors and the results manifest a sinusoidal relationship between the pointing error and the element position. The amplitude of this error was found to be dependent on the beam pointing angle and can be considered additive. Moreover, the effect of the amplitude and phase errors on the beam width and sidelobe levels was found to be insignificant. Element failures near the antenna center narrow the beam width and those near the edges increase it. Sidelobe levels were increased by 1 to 3 dB over a 1 dB amplitude tolerance and by 3 to 4 dB over a 10 deg phase tolerance range and hence still within acceptable limits. The MLS antenna array considered can still perform adequately with a failure of one third of its total number of elements. In addition, a formula was developed to predict the pointing error in terms of the pointing angle and phase quantization. The predicted and simulated results were in good agreement. CISTI

N92-14015# Allied-Signal Aerospace Co., Baltimore, MD.

MLS SYSTEM ERROR MODEL IDENTIFICATION AND SYNTHESIS

R. J. Kelly *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 22-28 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

A technique is described which can in principle identify the error sources in navigation systems and can also perform the inverse operation of synthesizing an error generator whose output is statistically equivalent to the original error data. A methodology is described for identifying the microwave landing system (MLS) error components (both deterministic and random) from flight error records. After the model has been identified, the error components are synthesized to form an MLS error generator. The difficult step in the model development is identifying the random error components. A general technique is presented for developing a statistically equivalent MLS error generator using only a fraction of the data storage required to store the actual flight test data (400:1 data compression). This is an important consideration because the error generator must have in storage a library representative of MLS signals worldwide. The random error model is synthesized using the latest computer algorithms in system identification theory to develop autoregressive moving average (ARMA) models. It is also determined whether the random error model of flight data measured at a given runway is statistically equivalent to the signals generated at other airports. In other words, is there some invariant signal structure in the random error components which can be generalized to simplify the aircraft flight control system (AFCS) engineer's design task. Precision distance measuring equipment (DME/P) flight test data recently collected by the Federal Aviation Administration (FAA) is analyzed to demonstrate the System Identification methodology. The technique applies to all navigation systems. CISTI

N92-14016# Micronav Ltd., Sydney (Nova Scotia).

FACTORY ACCEPTANCE TEST RANGE

Robert Janes and Malcolm MacNeil *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 29-31 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

In testing large antenna systems, including microwave landing

systems (MLS), the antenna range is often removed from the factory location for testing. This causes logistics problems in moving, packing and unpacking antennas. A range designed for factory acceptance testing provides a cost effective alternative to duplicating a design approval range. Micronav is in the process of establishing a factory acceptance test range adjacent to their facility at Sydney, Nova Scotia. To date, the Antenna Deck and Field Monitor portion of the range has been fully implemented. A temporary far field antenna using a jack-up tower is currently in use while the specification for the far field antenna tower is being finalized. The +40 and -40 antennas are in place but measurements must be made by taking the MLS receiver to the base of the tower. Completion of the range is anticipated in the first quarter of 1990. This range will provide an efficient, cost effective means to test MLS equipment in simulated installation to prove signal in space operation before the equipment leaves the factory floor. CISTI

N92-14017# Lisan Corp., Washington, DC.
DESIGN AND ANALYSIS TECHNIQUES FOR MLS SAFETY CRITICAL SOFTWARE
Susan H. Houston and Maryann Vickers *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 32-35 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Microwave landing systems (MLS) must meet stringent system integrity and continuity of service requirements. As software reliability cannot be quantified, it is essential that the software be designed and analyzed in a manner to meet technical requirements and minimized risk of degrading system integrity due to changes in its environment. This paper discusses recommended software design and development practices and includes an overview of safety analysis techniques using products of this design process to improve the software design and achieve system integrity goals. Safety critical software requires special considerations during design and development. These include rigorous requirements analysis and documentation, top down design, thorough software documentation, adherence to software quality assurance and configuration management practices, and performance of safety analysis with failure modes, effects, and criticality analysis to identify and account for all the ways the software can perform in its environment and react to hardware transients and failures. Testing must be designed to exercise the defensive mechanisms built into the software as a thorough software safety analysis. Many techniques exist for performing thorough software safety analysis; contractors should choose a combination of techniques to complement each other and be an integral part of their design and development processes. Automated tools should be used to assist in the design process and facilitate software analysis and test. CISTI

N92-14018# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
DME GROWTH ELEMENTS AND THEIR USE WITH MLS
A. Becker (Transport Canada Aviation, Ottawa, Ontario) *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 36-39 (For primary document see N92-14009 05-04)
(CNT Proj. 6902)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The TIME Reference Scanning Beam System, selected by the International Civil Aviation Organization (ICAO) as the standard microwave landing system (MLS), provides vertical and horizontal guidance in an approach sector of plus or minus 60 deg. Development of a 360 deg azimuth element to be integrated with the MLS was recommended. This paper describes a distance measuring equipment (DME) based concept for this application. The system utilizes the unused pulse space in the conventional DME systems to provide a 360 deg guidance subsystem. The system provides aircraft with a 360 deg azimuth element to be integrated with the microwave landing system (MLS). When hardware components of precision DME (DME/P) technology are used, the azimuth 2 sigma error can be kept below 0.2 deg. This accuracy is quite satisfying for the envisaged application. After the aircraft has landed, the complete position of the aircraft can be detected with high accuracy. By using the full data link capability, the information needed for a roll guidance and airport surveillance system can be made available on the ground as well as in the air. CISTI

N92-14019# E-Systems, Inc., Salt Lake City, UT.
DME/P TRANSPONDER REPLY DELAY ACCURACY: FACTORY VERIFICATION AND CALIBRATION
Elven H. Nisson *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 40-44 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

To avoid complication of site installation and to improve system test flow, it is critical to determine the reply delay performance of the precision distance measuring equipment (DME/P) portion of the microwave landing system (MLS) during testing on the factory floor. This paper describes methods of measuring and demonstrating that the critical reply delay performance parameters are met during the factory testing, including calibration of the test equipment for the measurements and calibration of the DME/P as part of the testing process. Sources of error in the measurement of reply delay in DME/P systems are discussed. The paper concludes with comparisons of DME/P performance at various stages from initial calibration and test at the factory through site installation, stationary testing, and flight testing. CISTI

N92-14020# Department of Transportation, Cambridge, MA.
TESTING MLS DME/P TRANSPONDERS AND INTERROGATORS
Paul E. Manning, Eric J. Pesciotta, and Joseph W. Ruggiero (Unisys Corp., Cambridge, MA.) *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 45-48 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper describes the microwave landing system (MLS) precision distance measuring equipment (DME/P) automated test system which was developed at the United States Dept. of Transportation, Transportation Systems Center. A requirement of the test system was that it should be easy to use by a knowledgable operator, and that it be automated to ensure procedural consistency. Equipment components are listed and the test equipment is described. Software, test procedures, and data processing procedures are described for time domain tests and frequency domain tests. Also described are test set calibration procedures and accuracy tests. This test equipment is capable of rapidly and accurately assessing the performance of both DME/P transponders and interrogators. The software used in the system is accepted by other government agencies and industry both in the United States and abroad. CISTI

N92-14021# Republic Electronics Co., Hauppauge, NY.
VALIDATION TESTING OF DME/P GROUND TRANSPONDERS AND AIRBORNE INTERROGATORS
John F. Michaels *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 49-52 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper describes the required performance and implementation for validation testing of precision distance measuring equipment (DME-P) ground transponders and airborne interrogators. DME-P system accuracies are specified in terms of path following error (PFE) and control motion noise (CMN) relating the signal to aircraft position errors and flight control dynamics. Factors contributing to degrade system accuracies are interrogator and transponder efficiencies, downlink and uplink garble, and multipath. DME error and power budgets must be properly allocated

to each system component. Both PFE and CMN separate and composite measurement configurations are discussed. The performance of a test set simulator (TSS) is described in two parts: as an interrogator evaluator and as a transponder evaluator. As a transponder evaluator, operation in a traffic loading mode is required in addition to evaluating performance. As part of traffic loading tests, random interleaved initial approach (IA) and final approach (FA) pulses in adjustable proportion are provided. The characteristics of pulses are precisely controlled in amplitude, time, phase, and frequency. The special techniques required for calibration of TSS are described. CISTI

N92-14022# Leigh Instruments Ltd., Kanata (Ontario).
A DME TRANSPONDER SYSTEM APPROACH FOR CONVERTIBILITY, MONITORING, AND DIAGNOSTICS
T. A. Hicks *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 53-56 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Both distance measuring equipment (DME) H and P transponders are currently in aviation navigation operational use. The transition from DME/H to DME/P design has not been regarded by the industry as a trivial task. This paper shows that by identifying common system requirements, the basis for a high degree of commonality is established for new equipment, and converting between P and H systems is relatively easily implemented. Interoperability of the two systems requires that the functional capability of both systems be built into a DME/P. The major performance issues affecting system design of a DME/P as compared to a DME/H are described. A design is described which can match the system requirements of both DME/P and DME/H. It incorporates a high degree of modularity based on basic system functional blocks. This design provides a good compromise among concerns and provides the flexibility of terminal control of the system and diagnostics. It also separates executive and diagnostics software, but provides critical monitoring of the hardware. CISTI

N92-14023# Canadian Marconi Co., Montreal (Quebec).
TESTING OF CMA-2000 MICROWAVE LANDING SYSTEM (MLS) AIRBORNE RECEIVER **c33**
L. Labreche and A. J. Murfin *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 57-59 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Microwave landing system (MLS) is a precision approach and landing guidance system which provides position information and various air to ground data. Position information is provided on a wide coverage sector and is determined by an azimuth angle measurement, an elevation angle measurement, and a range measurement. MLS performance standards and testing of the MLS airborne receiver is mainly governed by Technical Standard Order TSO-C104 issued by the Federal Aviation Administration. This TSO defines detailed test procedures for use in determining the required performance under standard and stressed conditions. It also imposes disciplines on software development and testing procedures. Testing performed on the CMA-2000 MLS receiver and methods used in its validation are described. A computer automated test system has been developed to test for compliance with RTCA/DO-177 Minimum Operation Performance Standards. Extensive software verification and traceability tests designed to ensure compliance with RTCA/DO-178 are outlined. CISTI

N92-14024# Micronav Ltd., Sydney (Nova Scotia).
MLS TESTING USING BUILT-IN TEST
Robert Janes and David Babineau *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 60-62 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

As microwave landing systems are specified to have extensive built-in test (BITE) capability, this aspect of the system's capabilities can be exploited to assist in testing at the factory as well as in the field. This capability does not end at simple functions such as power supply levels and error logging. This module has proven useful in factory testing of the antenna system as a whole as well as phase shifter measurements. This paper describes an example in which an offline monitor normally used to isolate failed phase shifters is used in the factory to identify problems with an assembled array antenna which could not be identified by testing of individual modules. Identification of these problems at a test range would mean much higher replacement costs. CISTI

N92-14025# Aviation Planning Services Ltd., Montreal (Quebec).
A STRATEGY FOR EXPLOITING THE FULL POTENTIAL OF MLS BASED TERMINAL PROCEDURES IN CANADA
K. Romi Singh *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 63-68 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper describes the regulatory research conducted in Canada in order to define the airspace requirements for microwave landing system (MLS) based terminal procedures. In particular, the extent of research and the time frame required for the translation of research findings into regulatory standards is addressed. It briefly explores some of the incremental compatibilities that research should bring to the operation of commercial air carriers such as the capacity to facilitate more through-put in the air traffic control system. Constraints which have prevented full exploitation of MLS by commercial air carriers are discussed. A discussion of concerns voiced by the user community, especially pilots, on the proposed replacement of instrument landing systems by MLS is provided. A review of industry concerns, Canada-specific applications and issues, and a proposal for a research strategy for Canada is also included. Projects on curved path and/or segmented path approaches, advanced procedures at multi-airport metropolitan areas, general aviation and/or computer capacity enhancement, and assessment of reduced landing minima are of particular interest to Canada from an operational point of view. CISTI

N92-14026# McMaster Univ., Hamilton (Ontario).
RADAR VISION **c32**
Simon Haykin *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 77-80 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper describes work undertaken at the Communications Research Laboratory (CRL) at McMaster University on a radar-based intelligent remote sensing device that is capable of developing an understanding or cognition of the surrounding environment. The proposed system has three levels of processing: (1) low level vision will perform preprocessing on incoming data; (2) intermediate level vision will perform feature extraction and target tracking; and (3) high level vision will perform knowledge processing for the purpose of target interpretation. A feedback link from this latter stage allows the radar to be automatically reconfigured for a different look at the target. Interactive probing of the potential target will continue until target recognition occurs. A sophisticated coherent cross polarizing radar with pulse compression capabilities, IPIX, has been developed and successfully tested in an ice infested marine environment off Newfoundland. Image analysis for IPIX is implemented on a Warp systolic machine, a highly parallel processor designed for vision research. A comparison between radar and human vision systems is provided. CISTI

N92-14027# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
A TAXI AND RAMP MANAGEMENT AND CONTROL SYSTEM (TARMAC) **c09**
U. Voelckers *In* Communications Gillies, Inc., Electronic Systems

in Transportation Sep. 1989 p 94-98 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

The development of safe and efficient low visibility ground operations has become very important with the increasing use of sophisticated systems such as Cat IIIa/b which allow all-weather approaches and landings. The high traffic rate at major airports has made improved ground operations important even for good weather. This paper outlines a general concept for a new airport ground movement control system (GMCS) currently under development at the German Aerospace Research Establishment (DLR). The GMCS system should provide complete information on the position, identity, and progress of aircraft and other vehicles operating in the movement area as well as supplying information on the positions of stationary hazards. Digital data should be used in approach, departure, and flow control. Communications with aircraft should be mainly via digital data and voice communications should be minimized. The system should provide the pilot with detailed guidance information. It should include automatic conflict avoidance and resolution. The system should be of modular design so that it can adapt to any airport structure and any traffic volume. It should have all-weather functionality, comply with International Civil Aviation Organization (ICAO) regulatory documents, and function as an integral part of air traffic control systems. CISTI

N92-14028# Mitre Corp., McLean, VA.
AUTOMATED PROBLEM RESOLUTION PROTOTYPE IN AUTOMATED EN ROUTE AIR TRAFFIC CONTROL
C. Vanessa Fong *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 99-102 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

Automated En Route Air Traffic Control (AERA) is part of the advanced automation system software currently being developed by the Federal Aviation Administration (FAA) to modernize the air traffic control system. Implementation of AERA involves three packages: AERA 1, AERA 2, and AERA 3. Automated problem resolution (APR) is a function within AERA 2 that generates resolution to conflicts detected by the automated problem detection function, and AERA 1 capability. In order to prepare APR algorithmic specifications for the advanced automation system, an APR prototype was developed in the FAA MITRE AERA 2 laboratory at the MITRE Corp. This prototype is a tool designed for evaluating rules and algorithms for resolving aircraft-aircraft and aircraft-space conflicts in both radar and nonradar environments. The evaluation is performed with FAA field evaluation personnel. The APR prototype is implemented in a Symbolics Lisp machine using the Knowledge Engineering Environment (KEE) expert systems shell. It has three major functions: conflict and resolution information display, problem detection, and resolution generation. This paper discusses the overall characteristics of the APR prototype and, specifically, the conflict and resolution information display, and the resolution generation capabilities of the prototype. CISTI

N92-14029# CompEngServ Ltd., Ottawa (Ontario).
A UNIQUE APPROACH TO AIRCRAFT CONFLICT RESOLUTION USING ARTIFICIAL INTELLIGENCE TECHNIQUES
I. G. Smith, C. A. Crabb, G. R. Ram, and M. R. Attisha *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 103-106 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

CompEngServ Ltd. has recently completed a project to develop and test a proof of concept, aircraft conflict resolution advisory system for non-radar airspace. This system, known as CORES (conflict resolution system), predicts losses of separation and presents ranked resolution alternatives. CORES deals with the difficult problem of convergence and has been successfully tested using a wide range of scenarios. The algorithm consists of three stages: (1) The initial resolution stage classifies the conflict as one of six different basic types and selects strategies to test accordingly. Strategies which induce no conflicts are selected. (2) The relax constraints stage, in which cases not resolved in stage one are subject to more extreme strategies in an attempt to discover a conflict free resolution. (3) If this fails the convergence stage is invoked. This stage examines all strategies which have previously failed because they induced one or more further conflicts. The goal of this stage is to suggest partial solutions which result in better overall airspace in terms of criticality and difficulty of induced conflicts. The system was successfully tested with a set of scenarios designed to exercise all stages of the algorithm. CISTI

N92-14030# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
COHERENT DETECTION OF INTERLEAVED TRELLIS ENCODED CPFSK FOR SHADOWED MOBILE SATELLITE CHANNELS **c32**
Ron W. Kerr and P. J. McLane *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 112-117 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

To date, modems for use on fading land mobile satellite (MSAT) channels, which employ coherent detection and interleaving, have used forms of phase shift keying (PSK) for the modulation scheme. The objective of this paper is to present a receiver that utilizes trellis coded continuous phase frequency shift keying (CPFSK) with coherent detection and convolutional interleaving of the coded symbols. A new decoding algorithm that copes with the interleaving is presented and uses both the modulation trellis and the code trellis. One earlier consideration considered trellis coded CPFSK with differential detection where decoding is based solely on the code trellis. The performance results are obtained by Monte-Carlo simulation and are partially verified through analysis. The fading model is Ricean, but the line-of-sight (LOS) component is subjected to a log-normal transformation that represents attenuations due to foliage, that will be referred to as shadowing. The main application for the receiver is low-speed-data transmission which requires a low bit error rate (BER) and has no delay constraints as in digital speech transmission. CISTI

N92-14031# National Research Council of Canada, Ottawa (Ontario). Flight Research Lab.
A HARD REAL-TIME OPERATING SYSTEM FOR AIRBORNE SCIENTIFIC EXPERIMENTS **c60**
J. E. Jordan *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 123-126 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

This paper describes a hard real time, multi-task operating system developed at the Flight Research Laboratory of the National Research Council of Canada (NRC) for airborne scientific experiments in oceanography, geophysics and navigation. Particular emphasis is given to task organization and scheduling and software development methods. One of the main requirements of this system was the ability to process sampled data in real time within the time frame defined by the sampling clock period. Failure to perform this processing by the next clock interrupt could result in serious errors which could jeopardize the objectives of experiments. Software development is an important consideration because of the nature of the system. A semi-mechanized configuration control system is described. Since debugging of software in flight is undesirable due to the cost and rigors of flight operations, a special ground refly mode of operation was developed to simulate the flight environment by replaying recorded flight tapes. This mode, which exercises most flight software from low-level device interrupt handlers to the application tasks, is described. CISTI

N92-14032# Array Systems Computing, Inc., Downsview (Ontario).
AUTOMATED BAGGAGE THREAT DETECTION c03
Thomas E. Feather, Adrian Lee-Kwen, Ling Guan, Stuart J. Berkowitz, and Maurice Audette (Transportation Development Centre, Montreal, Quebec) *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 135-138 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

A prototype system to detect potential threats as seen in x ray images of passenger carry-on baggage is described. The initial version concentrates on identifying handguns in real time. Objects found in the x ray image are classified into three categories representing varying degrees of potential danger. At the highest (red) level, the system attempts to detect all flat, non-occluded handguns. At the second (yellow) level, it attempts to detect all other non-occluded guns and areas that could hide a flat gun. All remaining dangerous objects are detected at the lowest (blue) level. Classified objects are highlighted in the x ray image with the color that corresponds to the object's threat level. The system is based on low cost computer hardware consisting of an 80386 PC, a display board, an interface board to the x ray machine, and a board with multiple high speed processors. A color graphics display with a touch screen is employed for the operator interface. A large selection of image manipulation functions are available to the operator via the touch screen. The system can also detect other dense threats such as pipe bombs, grenades, and bottles filled with liquid. It is currently being extended to detect additional objects, such as knives, scissors, electronic devices, and batteries. CISTI

N92-14033# Syms (Raymond A.) and Associates, Bridge Water, NJ.
OPERATIONAL SURVEY: VFR HELIPORT APPROACHES AND DEPARTURES Final Report
Raymond A. Syms and Randal A. Wiedemann Aug. 1991 66 p Prepared for Systems Control Technology, Inc., Arlington, VA
(Contract DTFA01-87-C-00014)
(SCT-91RR-26; DOT/FAA/RD-90/5) Avail: NTIS HC/MF A04

A field survey about helicopter performance and operational considerations pertaining to heliport design issues is documented. Helicopter operators, manufacturers' flight instructors, and FAA Technical Center pilots were surveyed in an attempt to relate their actual visual flight rule (VFR) helicopter operating techniques to heliport airspace requirements. The opinions and information obtained from the 88 pilots surveyed from around the country represent 17 types of helicopter models operating at a broad spectrum of density altitudes. The specific data has been summarized and characterized so as to be representative of the civil helicopter industry. Results show a wide variation in opinion, even among pilots flying the same aircraft models, about what constitutes safe straight approach and departure distances, adequate acceleration distances, and realistic climb angles. Pilots opinions indicate that they can climb at higher angles than are indicated by the profiles presented in Helicopter Physical and Performance Data, DOT/FAA/RD-90-3, in order to clear close-in obstacles. However, in flying these higher angles, pilots are flying through portions of the height/velocity envelope that the FAA and the manufacturers recommend be avoided. During the formal review process a number of FAA officials concluded that in many instances the pilots perceived performance capabilities that exceeded the aircrafts' performance capabilities. Also, of concern were instances when the aircraft could perform the maneuver, but the steep climb/descent angles needed would substantially increase the risk of an accident. Author

N92-14034# Computer Technology Associates, Inc., McKee City, NJ.
EVALUATION OF TRIPLE SIMULTANEOUS PARALLEL ILS APPROACHES SPACED 4300 FEET APART, PHASE 4A Final Report, Apr. 1990 - Oct. 1991
Lloyd Hitchcock, Terence Fischer, L. W. Bensel, Gloria Yastrop, Rickie Jones, Renee Luongo, Kimberly Reardon, and Barbara Starzel-Dehel Sep. 1991 139 p
(Contract DTFA03-89-C-00023)
(ACD-340; DOT/FAA/CT-91/6) Avail: NTIS HC/MF A07

This study was part of an ongoing effort to evaluate plans for increasing air traffic capacity and to evaluate the feasibility of using multiple simultaneous parallel Instrument Landing System (ILS) approaches. The objective was to evaluate the ability of experienced controllers to handle approach traffic during Instrument Meteorological Conditions (IMC). The proposed configuration consisted of triple parallel runways 10,000 ft long, spaced 4300 ft apart with even thresholds. The controllers were able to satisfactorily resolve more than 90 percent of the blunders in this simulation. Of the 244 blunders simulated, only 23 blunders resulted in aircraft violating the criterion miss distance of 500 ft. The controllers stated that they were able to maintain the 500-ft miss distance with the exception of a few 30 degree blunders (appendix A). The controllers indicated that a departure monitor position would be unnecessary because all of the functions of the departure monitor controller could be provided by local and departure control positions. Finally, the controllers reported that higher update rate radar sensors and improved displays would enhance their performance. The Multiple Parallel Technical Work Group (TWG), based on their observations during the simulations and their understanding of the contingencies that must be accounted for in such an operation, determined that triple simultaneous parallel approach operations spaced at 4300 ft would not be acceptable if controllers were required to use ASR-9 Radar and the Automated Radar Terminal System (ARTS) 3A displays. Author

N92-14035# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
RECOVERING HEADING FOR VISUALLY-GUIDED NAVIGATION
Ellen C. Hildreth Jun. 1991 39 p
(Contract N00014-85-K-0124)
(AD-A241249; AI-M-1297) Avail: NTIS HC/MF A03 CSCL 12/2

We present a model for recovering the direction of heading of an observer who is moving relative to a scene that may contain self-moving objects. The model builds upon an algorithm proposed by Rieger and Lawton (1985), which is based on earlier work by Longuet-Higgins and Prazdny (1981). The algorithm uses velocity differences computed in regions of high depth variation to estimate the location of the focus of expansion, which indicates the observer's heading direction. We relate the behavior of the proposed model to psychophysical observations regarding the ability of human observers to judge their heading direction, and show how the model can cope with self-moving objects in the environment. We also discuss this model in the broader context of a navigational system that performs tasks requiring rapid sensing and response through the interaction of simple task specific routines. GRA

N92-14036*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
IMAGE-BASED RANGING AND GUIDANCE FOR ROTORCRAFT Final Report
P. K. A. Menon Dec. 1991 79 p
(Contract NCC2-575)
(NASA-CR-184829; NAS 1.26:184829) Avail: NTIS HC/MF A05 CSCL 17G

Primary emphasis was on the development of vision-based navigation methods for rotorcraft nap-of-the-earth flight regime. A family of field-based ranging algorithms were developed. These ranging schemes are capable of handling both stereo and motion image sequences, and permits both translational and rotational camera motion. The algorithms require minimal computational effort and appear to be implementable in real time. A series of papers were presented on these ranging schemes, some of which are included in this report. A small part of the research effort was expanded on synthesizing a rotorcraft guidance law that directly

uses the vision-based ranging data; this work is discussed.
Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-14037*# United Technologies Research Center, East Hartford, CT.
HIGH TEMPERATURE STATIC STRAIN GAGE DEVELOPMENT Final Report, Jun. 1983 - Oct. 1990
C. O. Hulse, R. S. Bailey, H. P. Grant, W. L. Anderson, and J. S. Przybyszewski Aug. 1991 130 p
(Contract NAS3-23722)
(NASA-CR-189044; NAS 1.26:189044; R90-916528-80) Avail: NTIS HC/MF A07 CSCL 01C

Final results are presented from a program to develop a thin film static strain gage for use on the blades and vanes of running, test stand gas turbine engines with goals of an 3 x 3 mm gage area and total errors of less than 10 pct. of + or - 2,000 microstrain after 50 hrs at 1250 K. Pd containing 13 Wt. pct. Cr was previously identified as a new strain sensor alloy that appeared to be potentially usable to 1250 K. Subsequently, it was discovered, in contrast with its behavior in bulk, that Pd-13Cr suffered from oxidation attack when prepared as a 4.5 micron thick thin film. Continuing problems with electrical leakage to the substrate and the inability of sputtered alumina overcoats to prevent oxidation led to the discovery that sputtered alumina contains appreciable amounts of entrapped argon. After the argon has been exsolved by heating to elevated temperatures, the alumina films undergo a linear shrinkage of about 2 pct. resulting in formation of cracks. These problems can be largely overcome by sputtering the alumina with the substrate heated to 870 K. With 2 micron thick hot sputtered alumina insulation and overcoat films, total 50 hr drifts of about 100 microstrain (2 tests) and about 500 microstrain (1 test) were observed at 1000 and 1100 K, respectively. Results of tests on complete strain gage systems on constant moment bend bars with Pd temperature compensation grids revealed that oxidation of the Pd grid was a major problem even when the grid was overcoated with a hot or cold sputtered alumina overcoat.
Author

N92-14038*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering
INTEGRATION OF DYNAMIC, AERODYNAMIC, AND STRUCTURAL OPTIMIZATION OF HELICOPTER ROTOR BLADES Final Report, 15 Oct. 1986 - 30 Nov. 1991
David A. Peters 30 Nov. 1991 22 p
(Grant NAG1-710)
(NASA-CR-189018; NAS 1.26:189018) Avail: NTIS HC/MF A03 CSCL 01C

Summarized here is the first six years of research into the integration of structural, dynamic, and aerodynamic considerations in the design-optimization process for rotor blades. Specifically discussed here is the application of design optimization techniques for helicopter rotor blades. The reduction of vibratory shears and moments at the blade root, aeroelastic stability of the rotor, optimum airframe design, and an efficient procedure for calculating system sensitivities with respect to the design variables used are discussed.
Author

N92-14039*# Textron Bell Helicopter, Fort Worth, TX.
TECHNOLOGY NEEDS FOR HIGH SPEED ROTORCRAFT (3) Final Report
Jack DeTore and Scott Conway Oct. 1991 110 p
(Contract NAS2-13072)
(NASA-CR-177592; A-92013; NAS 1.26:177592) Avail: NTIS HC/MF A06 CSCL 01C

The spectrum of vertical takeoff and landing (VTOL) type aircraft is examined to determine which aircraft are most likely to achieve high subsonic cruise speeds and have hover qualities similar to a helicopter. Two civil mission profiles are considered: a 600-n.mi. mission for a 15- and a 30-passenger payload. Applying current technology, only the 15- and 30-passenger tiltfold aircraft are capable of attaining the 450-knot design goal. The two tiltfold aircraft at 450 knots and a 30-passenger tiltrotor at 375 knots were further developed for the Task II technology analysis. A program called High-Speed Total Envelope Proprotor (HI-STEP) is recommended to meet several of these issues based on the tiltrotor concept. A program called Tiltfold System (TFS) is recommended based on the tiltrotor concept. A task is identified to resolve the best design speed from productivity and demand considerations based on the technology that emerges from the recommended programs. HI-STEP's goals are to investigate propulsive efficiency, maneuver loads, and aeroelastic stability. Programs currently in progress that may meet the other technology needs include the Integrated High Performance Turbine Engine Technology (IHPTET) (NASA Lewis) and the Advanced Structural Concepts Program funded through NASA Langley.
Author

N92-14040 Department of the Navy, Washington, DC.
PYROFUZE AIRCRAFT ORDNANCE ARMING SYSTEM Patent
James M. Schaff, inventor (to Navy), Charles L. Maples, inventor (to Navy), Stephen F. Lyda, inventor (to Navy), David W. Brewton, inventor (to Navy), and Stephen R. Ritchie, inventor (to Navy) 27 Aug. 1991 6 p Filed 29 Mar. 1990
(AD-D015024; US-Patent-5,042,357; US-Patent-Appl-SN-502373; US-Patent-Class-89-1.550) Avail: US Patent and Trademark Office CSCL 19/2

This patent discloses a pyrofuze ordnance arming system, for air delivered ordnance, which provides a removable physical barrier to prevent the premature operation of ordnance device arming activation systems. An electrothermally initiated, alloyably removable pyrofuze pin extending from a pyrofuze device is employed as a physical barrier in an arming system to replace the conventional arming wires. The system increases safety and reliability for ordnance arming while decreasing the complexity and labor involved in preparing and loading ordnance on aircraft.
GRA

N92-14041*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics and Engineering Science.
FORMAL AND HEURISTIC SYSTEM DECOMPOSITION METHODS IN MULTIDISCIPLINARY SYNTHESIS Ph.D. Thesis, 1991
Christina L. Bloebaum Washington NASA. Langley Research Center Dec. 1991 164 p
(Grants NAG1-1004; NAG1-850)
(NASA-CR-4413; NAS 1.26:4413) Avail: NTIS HC/MF A08 CSCL 01C

The multidisciplinary interactions which exist in large scale engineering design problems provide a unique set of difficulties. These difficulties are associated primarily with unwieldy numbers of design variables and constraints, and with the interdependencies of the discipline analysis modules. Such obstacles require design techniques which account for the inherent disciplinary couplings in the analyses and optimizations. The objective of this work was to develop an efficient holistic design synthesis methodology that takes advantage of the synergistic nature of integrated design. A general decomposition approach for optimization of large engineering systems is presented. The method is particularly applicable for multidisciplinary design problems which are characterized by closely coupled interactions among discipline analyses. The advantage of subsystem modularity allows for implementation of specialized methods for analysis and optimization, computational efficiency, and the ability to incorporate human intervention and decision making in the form of an expert systems capability. The resulting approach is not a method

applicable to only a specific situation, but rather, a methodology which can be used for a large class of engineering design problems in which the system is non-hierarchic in nature. Author

N92-14042# Centre d'Essais Aeronautique Toulouse (France). Lab. des Materiaux Metalliques.
MECHANICAL QUALIFICATION TESTS FOR MATERIALS USED IN THE FABRICATION OF AIRCRAFT PARTS [ESSAIS MECANIQUES ENTRANT DANS LE CADRE DE LA QUALIFICATION DE MATERIAUX POUR LA REALISATION DE PIECES (AVION). PROCES-VERBAL DE L'ESSAI M5-5443/01]
J. C. Faure 12 Jun. 1991 64 p In FRENCH
(CEAT-M5-5443/01; ETN-92-99978) Avail: NTIS HC/MF A04

The mechanical tests performed to qualify several materials applied in aircraft components are described. The aim of the study is to define the rules concerning the principles of the tests and how to structure the results to be presented. The preparation of the sample, the test parameters and the analysis of the results are also defined. The tests were performed on light alloys, steels, titanium alloys and refractory alloys. The mechanical properties of the materials were evaluated by tests involving: resilience, strain, toughness, crack propagation and fatigue. The results of the mechanical tests are not included. ESA

N92-14043# Centre d'Essais Aeronautique Toulouse (France). Lab. des Essais Statiques.
OPTIMIZATION OF THE CALCULATION MARGINS OF LANDING GEARS UNDER EXTREME LOADS. RUPTURE STATIC TESTS. PART 1: PROGRAM AND TEST IMPLANTATION [OPTIMISATION DES MARGES DE CALCUL A CHARGE EXTREME POUR ATTERRISSEURS. ESSAIS STATIQUES A RUPTURE D'EPROUVETTES D'ETUDE. PROGRAMME ET INSTALLATION D'ESSAI. PROCES-VERBAL DE L'ESSAI S 8 6551 PARTIEL 1]
M. Laviron 5 Jul. 1991 30 p In FRENCH
(CEAT-S8-6551-Partiel-1-Pt-1; ETN-92-99979) Avail: NTIS HC/MF A03

The aim of the study is to evaluate the failure resistance of sample landing gear of different dimensions and of different materials. Simple or combined load tests are used. The purpose of the evaluation is to improve the laws and criteria in determining the most accurate failure parameters. Machined samples of steel and aluminum alloys are described. The samples were submitted to tensile, bending, and shear tests, which could be applied alone or combined. The cross sections of the samples were either tube, I, or H shaped. For each test performed, the extensometric equipment, the displacement sensors, and the measurement curves are given. ESA

N92-14044# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THE TWO-BAY CRACK PROBLEM IN FUSELAGES BUILT IN GLARE AND ARALL
K. J. J. M. Zaal May 1991 17 p
(LR-653; ETN-92-90418) Avail: NTIS HC/MF A03

The two bay crack problem as a possibly important subject for certification of pressurized fuselages is addressed. For fuselages with a GLARE or ARALL skin, the residual strength and remaining fatigue life after a large scale accidental damage seem to be realistic certification subjects. The evaluation of the two bay crack problem in a fuselage built in GLARE or Aramid Reinforced Aluminum Laminate (ARALL) introduces some new problems, compared to fuselages built in aluminum. The description of the anisotropy, the fast fracture behavior in GLARE and ARALL, require an extension of the design tools presently being used to evaluate the two bay crack problem in fuselages with aluminum skin. To model the residual strength of GLARE and ARALL, both the application of the K(sub I,C) factor and the R curve are being studied. Both methods can be used in design tools such as finite element methods and the displacement compatibility method. To study the remaining fatigue life of a fuselage with a damaged GLARE or ARALL skin, Marissen's fatigue crack growth model may be used. Slight simplifications, which are thought to lead to conservative results, may be required in Marissen's model for an efficient application in design tools intended to evaluate the two bay crack problem. ESA

N92-14045# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
BULGING OF FATIGUE CRACKS IN A PRESSURIZED AIRCRAFT FUSELAGE
D. Chen and J. Schijve May 1991 41 p Presented at the 16th ICAF Symposium, Tokyo, Japan, 22-24 May 1991
(LR-655; ETN-92-90420) Avail: NTIS HC/MF A03

Fatigue crack growth and residual strength must be considered as part of the damage problem of a pressurized aircraft fuselage. Longitudinal cracks offer problems because they occur in a curved thin sheet structure under biaxial loading conditions and internal pressure. The fatigue crack edges bulge outwards (out of plane deformation) which considerably complicates the fracture mechanics analysis. The problem is analyzed empirically and theoretically. Three test set ups were developed respectively for sheet specimens with a large radius of curvature loaded by internal air pressure and hoop stress. Fatigue crack growth and residual strength tests were carried out on aluminum alloy sheet specimens and some panels of new metal sheet/fiber laminates (Aramid Reinforced Aluminum Laminate (ARALL) and GLARE). Analytical relations were developed to obtain K values, which account for the nonlinear behavior associated with sheet curvature and bulging out of the crack edges. The predictions agree with the present test results, and with results from the literature obtained by finite element method calculations for fuselages and in full scale fatigue tests. ESA

N92-13929*# National Aerospace Lab., Amsterdam (Netherlands).
REVIEW OF AERODYNAMIC DESIGN IN THE NETHERLANDS
Th. E. Labrujere *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 1-30 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13930*# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
AERODYNAMIC AIRCRAFT DESIGN METHODS AND THEIR NOTABLE APPLICATIONS: SURVEY OF THE ACTIVITY IN JAPAN
Kozo Fujii and Susumu Takanashi (National Aerospace Lab., Tokyo, Japan) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 31-44 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13931*# Aviation Inst., Bucharest (Romania).
ON A GLOBAL AERODYNAMIC OPTIMIZATION OF A CIVIL TRANSPORT AIRCRAFT
G. Savu and O. Trifu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 45-54 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13932*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INVERSE AIRFOIL DESIGN PROCEDURE USING A MULTIGRID NAVIER-STOKES METHOD
J. B. Malone and R. C. Swanson *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 55-66 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13933*# Boeing Computer Services Co., Seattle, WA.
A COMPARISON OF TWO CLOSELY-RELATED APPROACHES TO AERODYNAMIC DESIGN OPTIMIZATION

G. R. Shubin and P. D. Frank *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 67-78 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13948*# Warsaw Technical Univ. (Poland). Inst. of Applied Mechanics and Aviation Technology.
DESIGN OF 3-DIMENSIONAL COMPLEX AIRPLANE CONFIGURATIONS WITH SPECIFIED PRESSURE DISTRIBUTION VIA OPTIMIZATION
Krzysztof Kubrynski *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 263-280 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13949*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Inst. of Theoretical Fluid Mechanics.
EXTENDED MAPPING AND CHARACTERISTICS TECHNIQUES FOR INVERSE AERODYNAMIC DESIGN
H. Sobieczky and Y. J. Qian *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 281-292 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13954*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
AERODYNAMIC SHAPE OPTIMIZATION OF ARBITRARY HYPERSONIC VEHICLES
George S. Dulikravich and Scott G. Sheffer *In its* Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 347-358 Sponsored in part by Pennsylvania State Univ., University Park (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13955*# Windsor Univ. (Ontario). Dept. of Mathematics and Statistics.
ANALYSIS AND DESIGN OF TRANSONIC AIRFOILS USING STREAMWISE COORDINATES
R. M. Barron and C.-F. An *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 359-370 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13958*# General Electric Co., Cincinnati, OH. Aircraft Engines.
AN INVERSE METHOD FOR THE AERODYNAMIC DESIGN OF THREE-DIMENSIONAL AIRCRAFT ENGINE NACELLES
R. A. Bell and R. D. Cedar *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 405-417 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VORTEX GENERATOR DESIGN FOR AIRCRAFT INLET DISTORTION AS A NUMERICAL OPTIMIZATION PROBLEM
Bernhard H. Anderson and Ralph Levy (Scientific Research Associates, Inc., Glastonbury, CT.) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 419-431 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 01C

N92-13981# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FLIGHT RESEARCH
J. H. deLeeuw and Tai Quach et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 76-77 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-14046# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
THE CONFLICTING FORCES DRIVING FUTURE AVIONICS ACQUISITION
Sep. 1991 207 p In ENGLISH and FRENCH Lecture series held in Kettering, MD, 16-17 Oct. 1991, in London, England, 4-5 Nov. 1991, and in Madrid, Spain, 7-8 Nov. 1991
(AGARD-LS-176; ISBN-92-835-0636-7) Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

There is a growing need to develop flexible/robust avionics to meet ever changing mission needs of the operational forces. Such needs may conflict with other required characteristics such as standardization, increased reliability, durability, and integrity. Weapon system costs and associated avionics costs continue to increase while military budgets continue to shrink due to the changing world conditions. Thus, it is even more important to intelligently resolve these often conflicting forces driving development efforts. These evolving trends, conflicts, and challenges are examined with a view to enhancing dialogue, understanding, and improved planning. For individual titles, see N92-14047 through N92-14058.

N92-14047# Aeronautical Systems Div., Wright-Patterson AFB, OH.
EVOLUTION OF AVIONIC SYSTEMS ARCHITECTURE, FROM THE 1950'S TO THE PRESENT
Gary L. Ludwig *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 7 p (For primary document see N92-14046 05-06)
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The evolution of the avionic systems architectures in the U.S. Air Force fighter aircraft is described, beginning with the system design typical of the Century Series aircraft (the F-100, F-101, etc.) and progressing on through the long list of fielded aircraft to the front-line fighters of today and beyond to the system currently under development at the Aeronautical Systems Division. In parallel with this description, the forcing functions and catalysts for change of avionic systems architecture are also noted. In this regard, the rapid shift to digital avionics made possible by the transistor and the integrated circuit, wafer-scale integration, and high-density mass memory devices has rapidly driven the evolution of avionic system architecture. Attendant with such technology advancements, pilot interface associated with each new generation of avionic subsystem has also continued to mature and this also has had a major impact on system design. With the ever-increasing capabilities of weapons systems, pilot workload has increased dramatically. The need for simplification, integration, and automation of operator functions has become abundantly clear. The evolution of system design features intended to ease the operator's burden have greatly influenced system design, and these impacts are also reviewed. In conclusion, a quick glimpse at future means of supporting the pilot is provided, and the implications on future avionic system design are reviewed. Author

N92-14048# Aeronautical Systems Div., Wright-Patterson AFB, OH.
AVIONICS STANDARDIZATION IN THE USAF: 1980 TO 1990
Nancy L. Clements *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 9 p (For primary

document see N92-14046 05-06)
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A review of avionics standardization from 1980-1990 is presented. Background, definitions, and anticipated benefits of avionics standardization are presented followed by the current extent of standards application and associated cost avoidance summaries. Lessons learned from the past 10 years are highlighted along with efforts underway to define a set of standardization, application, and implementation criteria designed to identify future avionics standardization initiatives and quantify anticipated benefits. Author

N92-14049# Boeing Military Airplane Development, Seattle, WA. Avionics Technology Div.
HISTORICAL PERSPECTIVE ON THE EVOLUTION OF AVIONICS STANDARDS
John C. Ruth *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 12 p (For primary document see N92-14046 05-06)
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An Avionics Laboratory major program, the Digital Avionics Information System (DAIS), played a key role in the evolution of interface standards from the late 1960's to the middle 1980's. The DAIS program considered interface standards in its basic concept and the cornerstones of the DAIS concept were: (1) A digital multiplex distribution system; (2) Functional software coded in a Higher Order Language; (3) A functional interface standard for processors in the form of a common instructional set architecture; and (4) A glass cockpit with interactive displays. The DAIS hypothesis was that significant ownership savings could be obtained on an aircraft and other weapon systems if some type of standard interfaces were established. Commonality of hardware was not the driving issue, but standards which defined the key interfaces and did not inhibit creative and innovative technology upgrades were imperative. The DAIS program endorsed many of the standards, 1553, 1589, 1750, and 1760, by which avionics designers now design highly integrated systems. Author

N92-14050# Ministry of Defence, Paris (France). Integration Div.
AVIONICS STANDARDIZATION IN EUROPE
L. Guibert *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 15 p (For primary document see N92-14046 05-06)
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Avionics standardization in Europe has relied upon common standards, such as Stanags. That approach is not rigid enough to ensure real interoperability, as will be demonstrated with the Link 16 example. It is foreseen that one of the major challenges for future avionics standardization will be the modularity. For some reasons, there must be international commonality in order to obtain minimization of costs. One important issue is the applicability of modular avionics on board European aircraft. This has been studied in France with relation to the Rafale. The results of that study will be discussed in some details. Another issue is the standardization of Instruction Set Architectures (ISA) in the field of data processing. That concept helps to solve some problems, such as software interchangeability and reconfigurability, but it also has drawbacks. A solution to the problem which does not imply common ISAs is predicted in France: the software bus. That concept, related to the Real Time Ada Extension program is proposed. It is clearly understood in Europe that modular avionics will gain maximum advantage if its F31 specifications are common to the different nations and services within NATO. This enforces the need for cooperation at both governmental and industrial levels. Europe has launched two multinational programs in order to define and validate a common avionics architecture for application in the next century: the ASAAC and the EUCLID CEPA 4. The scope and content of the first phase of these programs will be described. Author

N92-14051# Thomson-CSF, Malakoff (France). Radar and Counter-Measures Div.
MIXED APPROACH TOWARDS MODULAR AVIONICS CONFLICTING REQUIREMENTS
J. P. Lacroix *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 10 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

New development efforts like PAVE-PILLAR and PAVE-PACE in the US, EUCLID CEPA 4 in Europe, aim at architecture selection or standards recommendations in order to satisfy at least three requirement domains: LCC (life cycle cost) requirements; performance requirements, and availability requirements. A tool is described (graphic capture and simulation) which aims to bring some methodological help for designing modular integrated avionics systems, by allowing a more accurate analysis of their dynamical behavior. The refinement of the system modelization is tightly dependent on the performance of the simulation package. Author

N92-14052# Ministry of Defence, London (England).
AVIONICS SOFTWARE EVOLUTION
John A. Turton *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 17 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The critical software related aspects are reviewed, where thorough planning and implementation of philosophies and principles are needed, in order to be able to develop software based avionic systems to meet target timescales and budgets. Some of the critical software technologies are identified that will facilitate this process, both today and in the near future. The implications are described for software resulting from the currently emerging modular avionic architectures. A central theme is that the system and software generation process should be placed on as formal a theoretical basis as possible. This is in order to be able to deal effectively with the complexity of the software based avionic systems that are just around the corner. Author

N92-14053# Aeronautical Systems Div., Wright-Patterson AFB, OH.
COMMON AVIONICS BASELINE: THE PRODUCT OF THE JOINT INTEGRATED AVIONICS WORKING GROUP
Christopher L. Blake *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 12 p (For primary document see N92-14046 05-06)
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The JIAWG CAB is expected to have enormous influence on the entire next generation of avionic systems. It is imperative that good standardization decisions, based on a credible data base of design, test, and analysis, be used as the basis for CAB definition. Premature publication of specifications and standards whose content is not well founded and likely to change could cause resources to be wasted by the industry and could fatally undermine the credibility of this DOD avionics commonality thrust. The CAB development is concurrent with the development phases of the Light Helicopter and Advanced Tactical Fighter programs from which the data needed to close remaining technical issues will be derived. The JIAWG process provides a systematic way to define technical issues and alternative solutions and to draw on all valid data sources in establishing the preferred resolution of each issue. This process will be tightly coordinated with the weapon system programs to ensure specifications and standards incorporate adequate and current data from analysis and testing to complete each version of the CAB as part of planned weapon system development milestones. Author

N92-14054# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Systems Engineering Branch.
AVIONICS SYSTEMS DEVELOPMENT: TECHNOLOGICAL TRENDS, CONFLICTS, AND COST ISSUES IN A CHANGING EUROPEAN ENVIRONMENT
Helmut Rapp *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 15 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Presented here is an overview of German research and development projects generally known as modular avionics and their relationship to international initiatives. Growing system software complexity as well as rising software problems and cost have forced software development into rigid development methods and high order languages, and towards increasing standardization. Focussed upon are equipment standards that allow technology growth, maximize competition, and promote reusability of designs, and the avionics system software evolution and the experiences gained in the German TORNADO and F-4F upgrade programs. Author

N92-14055# Aeronautical Systems Div., Wright-Patterson AFB, OH.
AVIONICS MODERNIZATION/UPGRADES IN THE LATE 1990S
Ronald S. Vokits *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 5 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A number of issues relative to avionics upgrading are briefly discussed. Capability and supportability improvements; maintenance philosophy; availability, diagnostics, software, and packaging improvements; mixing of old and new technologies; standards; life cycles; and predictions are among the topics covered. Author

N92-14056# Aeronautical Systems Div., Wright-Patterson AFB, OH. Integrated Engineering and Technical Management Div.
AVIONICS RELIABILITY, DURABILITY, AND INTEGRITY: CAN THEY BE INDEPENDENT OF APPLICATION?
Harold W. Underwood *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 22 p (For primary document see N92-14046 05-06)
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The development of avionics through the application of traditional MIL-STD-785, Reliability Program for Systems and Equipment Development and Production development processes for avionic reliability has been proven to have several advantages, disadvantages, and limitations. This process is contrasted to the Avionics Integrity process which is based upon the knowledge of how the equipment is to be used, the actual environments of the operating equipment, and the application of fatigue theory and life laws to design. The process is based upon a detailed understanding of the characteristics of the parts, materials, and associated processes used in its manufacture, and the tailoring of the process controls, inspection, and test requirements. The outcome of the process will be avionics with a minimum life that is dependent upon the operational stresses applied. Additionally, a number of conflicts associated with the use of standard environments, standard parts, the use of redundancy, who is responsible for reliability, MIL-SPEC design criteria, mean time between failure as a metric, and warranties are also addressed. Author

N92-14057# Westinghouse Electric Corp., Baltimore, MD. Digital Systems Dept.
IMPLICATIONS OF INTEROPERABILITY AND STANDARDIZATION FOR THE INDUSTRIAL BASE
John C. Stuelpnagel *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 6 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A persistent problem for North Atlantic Treaty Organization (NATO) forces has been the difficulty of standardization and interoperability, due to conflicting political, economic, national, and industrial pressures. One approach to better accomplish standardization objectives has been the establishment of co-development programs, such as the Very High Speed Integrated Circuit (VHSIC) Avionics Modular Processor Program, in which the French and United States Governments have initiated the development of interoperable digital processing modules. However, conflicts in timing between development efforts and schedules for production and deployment of aircraft platforms has resulted in limited use of such modules in major aircraft programs. Several models for NATO standardization organizations are discussed which could address this problem and achieve significantly higher levels of interoperability in operational NATO equipment. Author

N92-14058# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH. Systems Integration Div.
AVIONICS TECHNOLOGY BEYOND 2000
Lester McFawn and D. R. Morgan *In* AGARD, The Conflicting Forces Driving Future Avionics Acquisition Sep. 1991 27 p (For primary document see N92-14046 05-06)
Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

If current trends continue, military avionics will face a very difficult situation at the turn of the century. This situation is predicted despite the impressive strides made in avionics performance, reduced weight per function, reduced cost per function, and a steady improvement in hardware reliability over the past 20 years. If we are unable to achieve a reasonably balanced affordability/availability/performance capability triad, there will be no other option than to substantially reduce either the number of weapon systems or their war-fighting capability. The basic architectural framework and modular avionics strategy needed to achieve this triad will soon be in place. Most of the needed enabling technologies are under development. The next step will be to carefully exploit, integrate, and validate these technologies in bold, innovative ways. Dramatic change will be needed in the way we integrate and share sensor functions; in the way we develop and support software; and in the design environments we use. Projected factors that will fundamentally impact future avionics systems and the implications of these factors are discussed along with avionics architecture, 21st century avionics software, and the future avionic system design environment. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-14059# Innovative Textile Applications Co., Grand Junction, CO.
UNIVERSAL WEAVING FOR TURBINE ENGINE COMPOSITE PREFORMS Final Report, Jul. 1990 - Mar. 1991
Konrad L. Krauland May 1991 47 p
(Contract F33615-90-C-2066)
(AD-A237667; WL-TR-91-2051) Avail: NTIS HC/MF A03
CSCL 11/5

The 3-D weaving/braiding technology being pursued at ITAC has the potential to result in techniques for manufacturing low cost, high volume, near net shape, multiaxially reinforced (through the thickness) fibrous preforms, utilizing a cartesian weaving/braiding plane, for high temperature composite applications. These techniques lend themselves to the manufacture of hybrid preforms; fiber assemblies that contain more than one

shape or fiber architecture. With this tool, designers may optimize the fiber structure and shape of a preform along the length of composite parts to maximize performance. A low cost hand loom has been designed and built to demonstrate concepts empirical to this technology, laying the ground work for a fully automated 3-D cartesian weaving machine. GRA

N92-14060# National Research Council of Canada, Ottawa (Ontario). Engine Lab.
RUB INDUCED ROTOR/STATOR VIBRATION ANALYSIS ON CF700 ENGINE
Bulent Tudes (Turkish Air Force Academy, Istanbul.) Jan. 1991 101 p Sponsored by Dept. of National Defence
(NRC-TR-Eng-007; CTN-91-60273) Copyright Avail: NTIS HC/MF A06

This report presents studies carried out on rub-induced rotor/stator vibrations on a CF700 gas turbine engine. The objectives of these studies were to develop signature analysis methodologies and condition monitoring techniques for the early detection of rub-induced instabilities. Spectral analysis was carried out to identify the changes in the levels at blade passing frequencies and other dominant peaks. Both amplitude and phase modulation techniques were employed to identify the rub-induced vibrations and derive parameters that could extract the characteristic features of the signals describing the changes due to several types of rubs. Signals acquired from displacement transducers were too low for any further analysis, as the casing of the engine was much too stiff to yield an enhanced signal. Author (CISTI)

N92-14061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PARTICLE-LADEN WEAKLY SWIRLING FREE JETS: MEASUREMENTS AND PREDICTIONS Ph.D. Thesis - Pennsylvania State Univ.
Daniel L. Bulzan May 1988 240 p
(NASA-TM-100881; E-2913; NAS 1.15:100881) Avail: NTIS HC/MF A11 CSCL 20D

A theoretical and experimental investigation of particle-laden, weakly swirling, turbulent free jets was conducted. Glass particles, having a Sauter mean diameter of 39 microns, with a standard deviation of 15 microns, were used. A single loading ratio (the mass flow rate of particles per unit mass flow rate of air) of 0.2 was used in the experiments. Measurements are reported for three swirl numbers, ranging from 0 to 0.33. The measurements included mean and fluctuating velocities of both phases, and particle mass flux distributions. Measurements were also completed for single-phase non-swirling and swirling jets, as baselines. Measurements were compared with predictions from three types of multiphase flow analysis, as follows: (1) locally homogeneous flow (LHF) where slip between the phases was neglected; (2) deterministic separated flow (DSF), where slip was considered but effects of turbulence/particle interactions were neglected; and (3) stochastic separated flow (SSF), where effects of both interphase slip and turbulence/particle interactions were considered using random sampling for turbulence properties in conjunction with random-walk computations for particle motion. Single-phase weakly swirling jets were considered first. Predictions using a standard k-epsilon turbulence model, as well as two versions modified to account for effects of streamline curvature, were compared with measurements. Predictions using a streamline curvature modification based on the flux Richardson number gave better agreement with measurements for the single-phase swirling jets than the standard k-epsilon model. For the particle-laden jets, the LHF and DSF models did not provide very satisfactory predictions. The LHF model generally overestimated the rate of decay of particle mean axial and angular velocities with streamwise distance, and predicted particle mass fluxes also showed poor agreement with measurements, due to the assumption of no-slip between phases. The DSF model also performed quite poorly for predictions of particle mass flux because turbulent dispersion of the particles was neglected. The SSF model, which accounts for both particle inertia and turbulent dispersion of the particles, yielded reasonably good predictions throughout the flow field for the particle-laden jets. Author

N92-14062# Department of the Navy, Washington, DC.
MUFFLER FOR AIR POWERED TURBINE DRIVE Patent Application
Mark J. Kiss, inventor (to Navy) 20 May 1991 15 p
(AD-D015034; US-Patent-Appl-SN-702570) Avail: NTIS HC/MF A03 CSCL 13/11

A muffler for an air powered turbine drive includes a cone section made of a perforated metal, a plurality of layers of sintered material on the inner surfaces of the cone section, an inner housing section substantially surrounding the cone section, an inner baffle wall between the inner housing section and the inner cone section, and an outer housing section substantially surrounding the inner housing section. Air entering the muffler through the cone section passes outwardly through the walls of the cone section and is then redirected several times before passing outwardly from the outer housing section in order to attenuate the noise in the air leaving the muffler without creating excessive muffler pressure. GRA

N92-14063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE AERODYNAMIC EFFECT OF FILLET RADIUS IN A LOW SPEED COMPRESSOR CASCADE Thesis - Von Karman Inst. for Fluid Dynamics
Brian P. Curlett Nov. 1991 49 p
(NASA-TM-105347; E-6717; NAS 1.15:105347) Avail: NTIS HC/MF A03 CSCL 21E

The aerodynamic effects of fillet size in a low speed compressor cascade were experimentally studied. Two blade profiles were used during the experiment, namely a controlled diffusion blade and a double circular arc blade. Cascades were tested with three fillet radii and two boundary layer thicknesses over a large range of incidence angles. The cascade performance was determined by extensive downstream flow measurements using a two head, 5 hole pressure probe. Results differ significantly between the two types of blades tested. As fillet radius increases secondary flows and total pressure losses were found to increase for the controlled diffusion blades; whereas, for the double circular arc blades the losses decrease, particularly at high incidence angles. Author

N92-14064# Systems Control Technology, Inc., Palo Alto, CA.
TURBINE ENGINE DIAGNOSTICS SYSTEM STUDY Final Report
Barbara K. McQuiston and Ronald L. DeHoff Oct. 1991 91 p
(Contract DTFA01-87-C-00014)
(DOT/FAA/CT-91/16) Avail: NTIS HC/MF A05

The results of a system study for the Turbine Engine Diagnostics (TED) program are presented. This research project was initiated to develop a method of approach and prototype design for a system capable of predicting the failure of rotating parts in turbine engines. Systems Control Technology (SCT) Inc. was contracted by the Federal Aviation Administration (FAA) and used an innovative approach that assimilated data from multiple sources for determining trends in engine performance and health. SCT initially performed an extensive technical literature search and industry survey to augment the present understanding of current technology in the industry for computerized diagnostics systems and measurement sensor technology. The result of this study is a proposed system with a method of approach that minimizes the technical and financial risk of turbine engines, while at the same time it optimizes the safety factors needed to accurately predict component failures. This proposed system is detailed. The abstracts from the literature search are included. Author

N92-13934*# Alabama Univ., Tuscaloosa. Dept. of Aerospace Engineering.
DESIGN OF THRUST VECTORING EXHAUST NOZZLES FOR REAL-TIME APPLICATIONS USING NEURAL NETWORKS
Ravi K. Prasanth, Robert E. Markin, and Kevin W. Whitaker *In*

Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 79-86 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13938*# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Cincinnati, OH.
RECENT PROGRESS IN INVERSE METHODS IN FRANCE
Pierre-Francois Bry, Olivier-Pierre Jacquotte, and Marie-Claire LePape (Office National d'Etudes et de Recherches Aeronautiques, Paris, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 123-144 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13939*# Shanghai Inst. of Mechanical Engineering (China). Lab. of Turbomachinery Aerodynamics.
RESEARCH ON INVERSE, HYBRID AND OPTIMIZATION PROBLEMS IN ENGINEERING SCIENCES WITH EMPHASIS ON TURBOMACHINE AERODYNAMICS: REVIEW OF CHINESE ADVANCES
Gao-Lian Liu *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 145-163 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13940*# Centre National de la Recherche Scientifique, Orsay (France).
THE TURBOMACHINE BLADING DESIGN USING S2-S1 APPROACH
T. S. Luu, L. Bencherif, B. Viney, and J. M. Nguyen Duc (Societe Europeenne de Propulsion, Vernon, France) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 165-176 Sponsored in part by Societe Europeenne de Propulsion (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13942*# National Technical Univ., Athens (Greece). Lab. of Thermal Turbomachines.
AN INVERSE INVISCID METHOD FOR THE DESIGN OF QUASI-THREE DIMENSIONAL ROTATING TURBOMACHINERY CASCADES
E. Bonataki, P. Chaviaropoulos, and K. D. Papailiou *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 189-200 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13943*# Skoe (Ivar Helge), Kongsberg (Norway).
A PC-BASED INVERSE DESIGN METHOD FOR RADIAL AND MIXED FLOW TURBOMACHINERY
Ivar Helge Skoe *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 201-212 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13952*# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BLADE DESIGN AND ANALYSIS USING A MODIFIED EULER SOLVER
O. Leonard and R. A. VandenBraembussche *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 325-336 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13956*# Fiat Aviazione S.p.A., Turin (Italy).
RESEARCH ON INVERSE METHODS AND OPTIMIZATION IN ITALY
Francesco Larocca *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 371-390 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13973*# Tsinghua Univ., Bejing (China). Dept. of Thermal Engineering.
DESIGN OF TRANSONIC COMPRESSOR CASCADES USING HODOGRAPH METHOD
Zuoyi Chen and Jingrong Guo *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 593-598 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 21E

N92-13977# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
AERODYNAMICS
J. D. DeLaurier, G. W. Johnston, D. W. Zingg, W. D. McKinney, C. Hayball, G. Saarenvirta, J. D. Lowe, B. Woodcock, S. Hulshoff, and H. Murty et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 54-58 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-14065# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel
KNOWLEDGE BASED SYSTEM APPLICATIONS FOR GUIDANCE AND CONTROL
Franco Canepa (Alenia, Torino, Italy) Jul. 1991 18 p Presented at the 51st Symposium, Madrid, Spain, 18-21 Sep. 1990
(AGARD-AR-284; ISBN-92-835-0624-3; CP-474) Copyright
Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

An evaluation of the technical papers contributed as part of the Guidance and Control Panel's symposium on knowledge based system applications is presented. The objectives of the symposium are outlined and each of the five sessions comprising the symposium is briefly summarized. These sessions addressed representative guidance and control applications, design concepts and synthesis techniques, related methods and techniques, information processing and system architecture, and mechanization and integration issues. General conclusions related to integration between artificial intelligence (AI) technologies and between AI and conventional technologies are given. All papers presented at the symposium were compiled as conference proceedings AGARD-CP-474. M.G.

N92-14066*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
RAPID NEAR-OPTIMAL AEROSPACE PLANE TRAJECTORY GENERATION AND GUIDANCE Final Report, 1 Dec. 1988 - 31 Aug. 1991
A. J. Calise, J. E. Corban, and N. Markopoulos Nov. 1991 38 p
(Grant NAG1-922)
(NASA-CR-189469; NAS 1.26:189469) Avail: NTIS HC/MF A03 CSCL 01C

Effort was directed toward the problems of the real time

trajectory optimization and guidance law development for the National Aerospace Plane (NASP) applications. In particular, singular perturbation methods were used to develop guidance algorithms suitable for onboard, real time implementation. The progress made in this research effort is reported. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-14067# Dayton Univ., OH.
TRAINING EVALUATION OF THE F-15 ADVANCED AIR COMBAT SIMULATION Final Technical Paper, Dec. 1988 - Mar. 1990
Michael R. Houck, Gary S. Thomas, and Herbert H. Bell Sep. 1991 79 p
(Contract F33615-90-C-0005)
(AD-A241675; AL-TP-1991-0047) Avail: NTIS HC/MF A05
CSCL 05/6

The objective of this investigation was to evaluate the utility of existing multiship simulations for training air combat tasks. Our previous evaluation, based on a limited sample of F-15 pilots, found that such simulator-based training was perceived to supplement existing F-15 continuation training. The present evaluation replicated the prior investigation with a broader subject sample of F-15 pilots. Mission-ready F-15 pilots and air weapons controllers participated in four days of training in simulated air combat missions. The simulation was designed to train two-ship F-15 tactics in an unrestricted combat environment that included multiple air and ground threats, electronic warfare, and real-time kill removal. Participants were surveyed before training to identify combat tasks for which they desired additional training. Following training, the participants rated the value of their continuation training and the simulation for practicing these air combat tasks. The results confirmed the previous evaluation in that pilots identified virtually the same cluster of combat tasks for which they felt the simulation provided desired and valuable training to supplement their continuation training. In summary, both pilots and air weapons controllers perceived that such simulator-based training could enhance their combat proficiency. GRA

N92-13982# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FLIGHT SIMULATION
L. D. Reid, S. Advani, W. O. Graf, R. J. Soosaar, P. R. Grant, P. A. Robinson, D. M. Chisholm, A. Hoppe, J. Kirdeikis, and R. A. Romano et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 78-79 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-13983# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
HYPERSONIC AERODYNAMICS
P. A. Sullivan, J. P. Sislian, J. J. Gottlieb, S. Molder, D. F. Hawken, A. Short, H. Stassen (Ryerson Polytechnical Inst., Toronto, Ontario), R. L. Deschambault, J. Z. Shen, and Y. Sheng et al *In Its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 86-89 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-14027# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.).
A TAXI AND RAMP MANAGEMENT AND CONTROL SYSTEM (TARMAC)
U. Voelckers *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 94-98 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-14068# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE. MISHIN MONOGRAPH ON FAILURE OF SOVIET MANNED LUNAR PROGRAM
V. P. Mishin 12 Nov. 1991 21 p Transl. into ENGLISH of Novoye v Zhizni, Nauke, Tekhnike: Seriya Kosmonavtika, Astronomiya (USSR), no. 12, 1990 p 1-19
(JPRS-USP-91-006) Avail: NTIS HC/MF A03

This translation of a Russian monograph is by a chief designer of the Soviet Space program who tries to answer many questions as to why the U.S.S.R. failed in its manned lunar program and why it failed to do so before the U.S. He, the author, concludes that (1) the U.S. at that time possessed higher scientific-technical and economic potentials than the Soviets; (2) in the U.S., the Apollo/Saturn program was a national, first priority program that was supposed to restore the country's prestige; (3) bewitched by their success in space, they underated the challenge issued by President Kennedy in 1961; and (4) they underestimated the scientific and technical difficulties of accomplishing such a mission. E.R.

N92-14096*# Computer Sciences Corp., Lanham, MD.
PROPELLANT-REMAINING MODELING
S. Torgovitsky *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 481-499 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-14069# Air Force Academy, CO.
ORBIT DETERMINATION ERROR ANALYSIS FOR AN INTERIOR LIBRATION POINT ORBIT IN THE SUN-EARTH+MOON ELLIPTIC RESTRICTED THREE-BODY PROBLEM Final Report
Steven C. Gordon Sep. 1991 105 p
(AD-A241690; USAFA-TR-91-12) Avail: NTIS HC/MF A06
CSCL 22/3

A spacecraft in a libration point orbit between the Earth and the Sun can be useful to study the interaction of the Sun's corona with the terrestrial environment. However, the spacecraft in such an orbit will drift from the nominal (unstable) path, and the forces individually have some level of uncertainty. Both range and range-rate tracking also include some inaccuracy in the data obtained. The accumulated error in the spacecraft's position and velocity relative to the nominal path after a predetermined period of tracking can be measured. This error, or uncertainty, in the spacecraft state is measured through simulations commonly referred to as orbit determination error analysis. The specific error analysis method used here is covariance analysis; the covariance matrix, after a predetermined period of tracking along the nominal path, contains the state uncertainties (state vector element variances) along its diagonal. GRA

N92-14070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FLIGHT MECHANICS/ESTIMATION THEORY SYMPOSIUM, 1991
Thomas Stengle, ed. Washington Oct. 1991 490 p Symposium

held in Greenbelt, MD, 21-23 May 1991
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Twenty-six papers and abstracts are presented. A wide range of issues related to orbit attitude prediction, orbit determination, and orbit control are examined including attitude sensor calibration, attitude dynamics, and orbit decay and maneuver strategy. Government, industry, and the academic community participated in the preparation and presentation of these papers. For individual titles, see N92-14071 through N92-14096.

N92-14071*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COSMIC BACKGROUND EXPLORER (COBE) NAVIGATION WITH TDRSS ONE-WAY RETURN-LINK DOPPLER IN THE POST-HELIUM-VENTING PHASE
M. Nemesure, J. Dunham, M. Maher (Bendix Field Engineering Corp., Columbia, MD.), J. Teles, and J. Jackson *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 3-22 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

A navigation experiment was performed which establishes Ultra-Stable Oscillator (USO) frequency stabilized one way return link Doppler TDRSS tracking data as a feasible option for mission orbit determination support at the Goddard Space Center Flight Dynamics Facility. The study was conducted using both one way and two way Tracking and Data Relay Satellite System (TDRSS) tracking measurements for the Cosmic Background Explorer (COBE) spacecraft. Tracking data for a 4 week period immediately follow the depletion of the helium supply was used. The study showed that, for both definitive orbit solution and short term orbit prediction (up to 4 weeks), orbit determination results based on one way return link Doppler tracking measurements are comparable to orbit determination results based on two way range and two way Doppler tracking measurements. Author

N92-14072*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PRELIMINARY NAVIGATION ACCURACY ANALYSIS FOR THE TDRSS ONBOARD NAVIGATION SYSTEM (TONS) EXPERIMENT ON EP/EUVE
C. J. Gramling, A. C. Long, T. Lee, N. A. Ottenstein, and M. V. Samii (Computer Sciences Corp., Lanham, MD.) *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 23-44 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

A Tracking and Data Relay Satellite System (TDRSS) Onboard Navigation System (TONS) is currently being developed by NASA to provide a high accuracy autonomous navigation capability for users of TDRSS and its successor, the Advanced TDRSS (ATDRSS). The fully autonomous user onboard navigation system will support orbit determination, time determination, and frequency determination, based on observation of a continuously available, unscheduled navigation beacon signal. A TONS experiment will be performed in conjunction with the Explorer Platform (EP) Extreme Ultraviolet Explorer (EUVE) mission to flight quality TONS Block 1. An overview is presented of TONS and a preliminary analysis of the navigation accuracy anticipated for the TONS experiment. Descriptions of the TONS experiment and the associated navigation objectives, as well as a description of the onboard navigation algorithms, are provided. The accuracy of the selected algorithms is evaluated based on the processing of realistic simulated TDRSS one way forward link Doppler measurements. The analysis process is discussed and the associated navigation accuracy results are presented. Author

N92-14073*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ANALYSIS OF NAVIGATION PERFORMANCE FOR THE EARTH OBSERVING SYSTEM (EOS) USING THE TDRSS ONBOARD NAVIGATION SYSTEM (TONS)
B. Elrod, A. Kapoor, David C. Folta, and K. Liu (Computer Sciences Corp., Silver Spring, MD.) *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 45-64 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

Use of the Tracking and Data Relay Satellite System (TDRSS) Onboard Navigation System (TONS) was proposed as an alternative to the Global Positioning System (GPS) for supporting the Earth Observing System (EOS) mission. The results are presented of EOS navigation performance evaluation with respect to TONS based orbit, time, and frequency determination (OD/TD/FD). Two TONS modes are considered: one uses scheduled TDRSS forward link service to derive one way Doppler tracking data for OD/FD support (TONS-I); the other uses an unscheduled navigation beacon service (proposed for Advanced TDRSS) to obtain pseudorange and Doppler data for OD/TD/FD support (TONS-II). Key objectives of the analysis were to evaluate nominal performance and potential sensitivities, such as suboptimal tracking geometry, tracking contact scheduling, and modeling parameter selection. OD/TD/FD performance predictions are presented based on covariance and simulation analyses. EOS navigation scenarios and the contributions of principal error sources impacting performance are also described. The results indicate that a TONS mode can be configured to meet current and proposed EOS position accuracy requirements of 100 and 50 m, respectively. Author

N92-14074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FLIGHT DYNAMICS FACILITY OPERATIONAL ORBIT DETERMINATION SUPPORT FOR THE OCEAN TOPOGRAPHY EXPERIMENT
D. T. Bolvin, A. F. Schanzle, M. V. Samii (Computer Sciences Corp., Lanham, MD.), and C. E. Doll *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 65-77 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

The Ocean Topography Experiment (TOPEX/POSEIDON) mission is designed to determine the topography of the Earth's sea surface across a 3 yr period, beginning with launch in June 1992. The Goddard Space Flight Center Dynamics Facility has the capability to operationally receive and process Tracking and Data Relay Satellite System (TDRSS) tracking data. Because these data will be used to support orbit determination (OD) aspects of the TOPEX mission, the Dynamics Facility was designated to perform TOPEX operational OD. The scientific data require stringent OD accuracy in navigating the TOPEX spacecraft. The OD accuracy requirements fall into two categories: (1) on orbit free flight; and (2) maneuver. The maneuver OD accuracy requirements are of two types; premaneuver planning and postmaneuver evaluation. Analysis using the Orbit Determination Error Analysis System (ODEAS) covariance software has shown that, during the first postlaunch mission phase of the TOPEX mission, some postmaneuver evaluation OD accuracy requirements cannot be met. ODEAS results also show that the most difficult requirements to meet are those that determine the change in the components of velocity for postmaneuver evaluation. Author

N92-14075*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COMPARISON OF ERBS ORBIT DETERMINATION ACCURACY USING BATCH LEAST-SQUARES AND SEQUENTIAL METHODS
D. H. Oza, T. L. Jones, S. M. Fabien (Computer Sciences Corp., Lanham, MD.), G. D. Mistretta, R. C. Hart, and C. E. Doll *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 79-96 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

The Flight Dynamics Div. (FDD) at NASA-Goddard commissioned a study to develop the Real Time Orbit

Determination/Enhanced (RTOD/E) system as a prototype system for sequential orbit determination of spacecraft on a DOS based personal computer (PC). An overview is presented of RTOD/E capabilities and the results are presented of a study to compare the orbit determination accuracy for a Tracking and Data Relay Satellite System (TDRSS) user spacecraft obtained using RTOS/E on a PC with the accuracy of an established batch least squares system, the Goddard Trajectory Determination System (GTDS), operating on a mainframe computer. RTOD/E was used to perform sequential orbit determination for the Earth Radiation Budget Satellite (ERBS), and the Goddard Trajectory Determination System (GTDS) was used to perform the batch least squares orbit determination. The estimated ERBS ephemerides were obtained for the Aug. 16 to 22, 1989, timeframe, during which intensive TDRSS tracking data for ERBS were available. Independent assessments were made to examine the consistencies of results obtained by the batch and sequential methods. Comparisons were made between the forward filtered RTOD/E orbit solutions and definitive GTDS orbit solutions for ERBS; the solution differences were less than 40 meters after the filter had reached steady state. Author

N92-14076*# Rockwell Space Operations Co., Houston, TX.
NAVIGATION OF THE TSS-1 MISSION
Timothy C. Jackson, John G. Pido, and Patrick L. Zimmerman *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 97-121 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

The Tethered Satellite System Mission was analyzed to determine its impacts on the Mission Control Center (MCC) Navigation section's ability to maintain an accurate state vector for the Space Shuttle during nominal and off-nominal flight operations. Tether dynamics expected on the Shuttle introduces new phenomena when determining the best estimation of its position and velocity. In the analysis, emphasis was placed on determining the navigation state vectors accuracies resulting when the tether induced forces were and were not modeled as an additional acceleration upon processing tracking measurements around a TSS-1 trajectory. Results of the analyses show that when the forces are not modeled in the state vector generation process, the resulting solution state reflects a solution about the center of gravity of the tethered system and not that of the orbiter. The Navigation team's ability to provide accurate state vector estimates necessary for trajectory planning are impeded. In addition to this consequent, is an impact on Onboard Navigation state vector accuracies. These analyses will show that in order to preserve an accurate state onboard the orbiter a new operational procedure would have to be adopted. Author

N92-14077*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
NEW QUESTS FOR BETTER ATTITUDES
Malcolm D. Shuster *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 125-137 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

During the past few years considerable insight was gained into the QUEST algorithm both as a maximum likelihood estimator and as a Kalman filter/smoother for systems devoid of dynamical noise. The new algorithms and software are described and analytical comparisons are made with the more conventional attitude Kalman filter. It is also described how they may be accommodated to noisy dynamical systems. Author

N92-14078*# Computer Sciences Corp., Lanham, MD.
COBE EXPERIENCE WITH FILTER QUEST
O. Filla, J. Keat, and D. Chu *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 139-150 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

A gyro based filter variation on the standard QUEST attitude determination algorithm is applied to the Cosmic Background Explorer (COBE). Filter QUEST is found to be three times as fast as the batch estimator and slightly more accurate than regular QUEST. Perhaps more important than its speed or accuracy is the fact that Filter QUEST can provide real time attitude solutions when regular QUEST cannot, due to lack of observability. Filter QUEST is also easy to use and adjust for the proper memory length. Suitable applications for Filter QUEST include coarse and real time attitude determination. Author

N92-14079*# ST Systems Corp., Lanham, MD.
COBE GROUND SEGMENT ATTITUDE DETERMINATION
V. K. Kumar, I. Freedman, E. L. Wright, and F. S. Patt (General Sciences Corp., Laurel, MD.) *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 151-166 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

The Cosmic Background Explorer (COBE) spacecraft was launched in November 1989 by NASA to survey the sky for primordial radiation left from the Big Bang explosion. The success of the mission requires an accurate determination of the spacecraft attitude. While the accuracy of the attitude obtained from the attitude sensors is adequate for two of the experiments, the higher accuracy required by the Diffuse Infrared Background Experiment (DIRBE) is obtained by using the DIRBE instrument as a special type of star sensor. Presented here is an overview of the attitude processing algorithms used at the Cosmology Data Analysis Center (CDAC) and the results obtained from the flight data. Author

N92-14080*# ST Systems Corp., Lanham, MD.
COBE GROUND SEGMENT GYRO CALIBRATION **c19**
I. Freedman, V. K. Kumar, A. Rae, R. Venkataraman, F. S. Patt, and E. L. Wright (California Univ., Los Angeles.) *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 167-185 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

Discussed here is the calibration of the scale factors and rate biases for the Cosmic Background Explorer (COBE) spacecraft gyroscopes, with the emphasis on the adaptation for COBE of an algorithm previously developed for the Solar Maximum Mission. Detailed choice of parameters, convergence, verification, and use of the algorithm in an environment where the reference attitudes are determined form the Sun, Earth, and star observations (via the Diffuse Infrared Background Experiment (DIRBE) are considered. Results of some recent experiments are given. These include tests where the gyro rate data are corrected for the effect of the gyro baseplate temperature on the spacecraft electronics. Author

N92-14081*# Computer Sciences Corp., Lanham, MD.
EVIDENCE OF CHAOTIC PATTERN IN SOLAR FLUX THROUGH A REPRODUCIBLE SEQUENCE OF PERIOD-DOUBLING-TYPE BIFURCATIONS **c92**
S. Ashrafi and L. Roszman *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 189-207 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

Presented here is a preliminary study of the limits to solar flux intensity prediction, and of whether the general lack of predictability in the solar flux arises from the nonlinear chaotic nature of the Sun's physical activity. Statistical analysis of a chaotic signal can extract only its most gross features, and detailed physical models fail, since even the simplest equations of motion for a nonlinear system can exhibit chaotic behavior. A recent theory by Feigenbaum suggests that nonlinear systems that can be led into chaotic behavior through a sequence of period-doubling bifurcations will exhibit a universal behavior. As the control parameter is

increased, the bifurcation points occur in such a way that a proper ratio of these will approach the universal Feigenbaum number. Experimental evidence supporting the applicability of the Feigenbaum scenario to solar flux data is sparse. However, given the hypothesis that the Sun's convection zones are similar to a Rayleigh-Bernard mechanism, we can learn a great deal from the remarkable agreement observed between the prediction by theory (period doubling - a universal route to chaos) and the amplitude decrease of the signal's regular subharmonics. The authors show that period-doubling-type bifurcation is a possible route to a chaotic pattern of solar flux that is distinguishable from the logarithm of its power spectral density. This conclusion is the first positive step toward a reformulation of solar flux by a nonlinear chaotic approach. The ultimate goal of this research is to be able to predict an estimate of the upper and lower bounds for solar flux within its predictable zones. Naturally, it is an important task to identify the time horizons beyond which predictability becomes incompatible with computability. Author

N92-14082*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

IONOSPHERIC REFRACTION EFFECTS ON TOPEX ORBIT DETERMINATION ACCURACY USING THE TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS)

M. S. Radomski (Computer Sciences Corp., Lanham, MD.) and C. E. Doll *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 209-228 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

This investigation concerns the effects on Ocean Topography Experiment (TOPEX) spacecraft operational orbit determination of ionospheric refraction error affecting tracking measurements from the Tracking and Data Relay Satellite System (TDRSS). Although tracking error from this source is mitigated by the high frequencies (K-band) used for the space-to-ground links and by the high altitudes for the space-to-space links, these effects are of concern for the relatively high-altitude (1334 kilometers) TOPEX mission. This concern is due to the accuracy required for operational orbit-determination by the Goddard Space Flight Center (GSFC) and to the expectation that solar activity will still be relatively high at TOPEX launch in mid-1992. The ionospheric refraction error on S-band space-to-space links was calculated by a prototype observation-correction algorithm using the Bent model of ionosphere electron densities implemented in the context of the Goddard Trajectory Determination System (GTDS). Orbit determination error was evaluated by comparing parallel TOPEX orbit solutions, applying and omitting the correction, using the same simulated TDRSS tracking observations. The tracking scenarios simulated those planned for the observation phase of the TOPEX mission, with a preponderance of one-way return-link Doppler measurements. The results of the analysis showed most TOPEX operational accuracy requirements to be little affected by space-to-space ionospheric error. The determination of along-track velocity changes after ground-track adjustment maneuvers, however, is significantly affected when compared with the stringent 0.1-millimeter-per-second accuracy requirements, assuming uncoupled premaneuver and postmaneuver orbit determination. Space-to-space ionospheric refraction on the 24-hour postmaneuver arc alone causes 0.2 millimeter-per-second errors in along-track delta-v determination using uncoupled solutions. Coupling the premaneuver and postmaneuver solutions, however, appears likely to reduce this figure substantially. Plans and recommendations for response to these findings are presented.
Author

N92-14083*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

STUDY OF GEOPOTENTIAL ERROR MODELS USED IN ORBIT DETERMINATION ERROR ANALYSIS

C. Yee, D. Kelbel, T. Lee, M. V. Samii (Computer Sciences Corp., Lanham, MD.), G. D. Mistretta, and R. C. Hart *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 229-248 (For primary document see N92-14070 05-13)
(Contract NAS5-31500)
Avail: NTIS HC/MF A21 CSCL 22A

The uncertainty in the geopotential model is currently one of the major error sources in the orbit determination of low-altitude Earth-orbiting spacecraft. The results of an investigation of different geopotential error models and modeling approaches currently used for operational orbit error analysis support at the Goddard Space Flight Center (GSFC) are presented, with emphasis placed on sequential orbit error analysis using a Kalman filtering algorithm. Several geopotential models, known as the Goddard Earth Models (GEMs), were developed and used at GSFC for orbit determination. The errors in the geopotential models arise from the truncation errors that result from the omission of higher order terms (omission errors) and the errors in the spherical harmonic coefficients themselves (commission errors). At GSFC, two error modeling approaches were operationally used to analyze the effects of geopotential uncertainties on the accuracy of spacecraft orbit determination - the lumped error modeling and uncorrelated error modeling. The lumped error modeling approach computes the orbit determination errors on the basis of either the calibrated standard deviations of a geopotential model's coefficients or the weighted difference between two independently derived geopotential models. The uncorrelated error modeling approach treats the errors in the individual spherical harmonic components as uncorrelated error sources and computes the aggregate effect using a combination of individual coefficient effects. This study assesses the reasonableness of the two error modeling approaches in terms of global error distribution characteristics and orbit error analysis results. Specifically, this study presents the global distribution of geopotential acceleration errors for several gravity error models and assesses the orbit determination errors resulting from these error models for three types of spacecraft - the Gamma Ray Observatory, the Ocean Topography Experiment, and the Cosmic Background Explorer.
Author

N92-14084*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

INCREASED EPHEMERIS ACCURACY USING ATTITUDE-DEPENDENT AERODYNAMIC FORCE COEFFICIENTS FOR INERTIALLY STABILIZED SPACECRAFT **c02**

David C. Folta and David F. Baker *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 249-264 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 01A

The FREEMAC program used to generate the aerodynamic coefficients, as well as associated routines that allow the results to be used in other software is described. These capabilities are applied in two numerical examples to the short-term orbit prediction of the Gamma Ray Observatory (GRO) and Hubble Space Telescope (HST) spacecraft. Predictions using attitude-dependent aerodynamic coefficients were made on a modified version of the PC-based Ephemeris Generation Program (EPHGEN) and were compared to definitive orbit solutions obtained from actual tracking data. The numerical results show improvement in the predicted semi-major axis and along-track positions that would seem to be worth the added computational effort. Finally, other orbit and attitude analysis applications are noted that could profit from using FREEMAC-calculated aerodynamic coefficients, including orbital lifetime studies, orbit determination methods, attitude dynamics simulators, and spacecraft control system component sizing.
Author

N92-14085*# McDonnell-Douglas Space Systems Co., Houston, TX. Engineering Services Div.

ELIMINATION OF SECULAR TERMS FROM THE DIFFERENTIAL EQUATIONS FOR THE ELEMENTS OF PERTURBED TWO-BODY MOTION **c64**

Victor R. Bond and Michael F. Fraietta *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 265-283 (For primary document

see N92-14070 05-13)
(Contract NAS9-17885)
Avail: NTIS HC/MF A21 CSCL 12A

In 1961, Sperling linearized and regularized the differential equations of motion of the two-body problem by changing the independent variable from time to fictitious time by Sundman's transformation (r = dt/ds) and by embedding the two-body energy integral and the Laplace vector. In 1968, Burdet developed a perturbation theory which was uniformly valid for all types of orbits using a variation of parameters approach on the elements which appeared in Sperling's equations for the two-body solution. In 1973, Bond and Hanssen improved Burdet's set of differential equations by embedding the total energy (which is a constant when the potential function is explicitly dependent upon time.) The Jacobian constant was used as an element to replace the total energy in a reformulation of the differential equations of motion. In the process, another element which is proportional to a component of the angular momentum was introduced. Recently trajectories computed during numerical studies of atmospheric entry from circular orbits and low thrust beginning in near-circular orbits exhibited numerical instability when solved by the method of Bond and Gottlieb (1989) for long time intervals. It was found that this instability was due to secular terms which appear on the righthand sides of the differential equations of some of the elements. In this paper, this instability is removed by the introduction of another vector integral called the delta integral (which replaces the Laplace Vector) and another scalar integral which removes the secular terms. The introduction of these integrals requires a new derivation of the differential equations for most of the elements. For this rederivation, the Lagrange method of variation of parameters is used, making the development more concise. Numerical examples of this improvement are presented. Author

N92-14086*# Naval Observatory, Washington, DC. Orbital Mechanics Dept.

IMPROVED ACCURACIES FOR SATELLITE TRACKING c74

P. C. Kammeyer, A. D. Fiala, and P. K. Seidelmann *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 285-297 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 20F

A charge coupled device (CCD) camera on an optical telescope which follows the stars can be used to provide high accuracy comparisons between the line of sight to a satellite, over a large range of satellite altitudes, and lines of sight to nearby stars. The CCD camera can be rotated so the motion of the satellite is down columns of the CCD chip, and charge can be moved from row to row of the chip at a rate which matches the motion of the optical image of the satellite across the chip. Measurement of satellite and star images, together with accurate timing of charge motion, provides accurate comparisons of lines of sight. Given lines of sight to stars near the satellite, the satellite line of sight may be determined. Initial experiments with this technique, using an 18 cm telescope, have produced TDRS-4 observations which have an rms error of 0.5 arc second, 100 m at synchronous altitude. Use of a mosaic of CCD chips, each having its own rate of charge motion, in the focal place of a telescope would allow point images of a geosynchronous satellite and of stars to be formed simultaneously in the same telescope. The line of sight of such a satellite could be measured relative to nearby star lines of sight with an accuracy of approximately 0.03 arc second. Development of a star catalog with 0.04 arc second rms accuracy and perhaps ten stars per square degree would allow determination of satellite lines of sight with 0.05 arc second rms absolute accuracy, corresponding to 10 m at synchronous altitude. Multiple station time transfers through a communications satellite can provide accurate distances from the satellite to the ground stations. Such observations can, if calibrated for delays, determine satellite orbits to an accuracy approaching 10 m rms. Author

N92-14087*# Rockwell Space Operations Co., Houston, TX. Guidance and Navigation Analyst.

TESTING OF THE HIGH ACCURACY INERTIAL NAVIGATION SYSTEM IN THE SHUTTLE AVIONICS INTEGRATION LAB c19

Russell L. Strachan and James M. Evans *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 301-320 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

The description, results, and interpretation is presented of comparison testing between the High Accuracy Inertial Navigation System (HAINS) and KT-70 Inertial Measurement Unit (IMU). The objective was to show the HAINS can replace the KT-70 IMU in the space shuttle Orbiter, both singularly and totally. This testing was performed in the Guidance, Navigation, and Control Test Station (GTS) of the Shuttle Avionics Integration Lab (SAIL). A variety of differences between the two instruments are explained. Four, 5 day test sessions were conducted varying the number and slot position of the HAINS and KT-70 IMUs. The various steps in the calibration and alignment procedure are explained. Results and their interpretation are presented. The HAINS displayed a high level of performance accuracy previously unseen with the KT-70 IMU. The most significant improvement of the performance came in the Tuned Inertial/Extended Launch Hold tests. The HAINS exceeded the 4 hr specification requirement. The results obtained from the SAIL tests were generally well beyond the requirements of the procurement specification. Author

N92-14088*# California Univ., Davis. Dept. of Mechanical, Aeronautical and Materials Engineering.

EFFECTIVENESS OF LARGE BOOMS AS NUTATION DAMPERS FOR SPIN STABILIZED SPACECRAFT c18

F. O. Eke *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 321-331 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

The issue of using long slender booms as pendulous nutation damping devices on spinning aircraft is discussed. Motivation comes from experience with the Galileo Spacecraft, whose magnetometer boom also serves as a passive nutation damper for the spacecraft. Performance analysis of a spacecraft system equipped with such systems are relatively insensitive to changes in the damping constant of the device. However, the size and arrangement of such a damper raises important questions concerning spacecraft stability in general. Author

N92-14089*# Space Telescope Science Inst., Baltimore, MD.

AN ANALYSIS OF THE HUBBLE SPACE TELESCOPE FINE GUIDANCE SENSOR FINE LOCK MODE c89

L. G. Taff *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 333-352 (For primary document see N92-14070 05-13)
(Contract NAS5-26555)
Avail: NTIS HC/MF A21 CSCL 03A

There are two guiding modes of the Hubble Space Telescope (HST) used for the acquisition of astronomical data by one of its six scientific instruments. The more precise one is called Fine Lock. Command and control problems in the onboard electronics has limited Fine Lock to brighter stars, V less than 13.0 mag, instead of fulfilling its goal of V = 14.5 mag. Consequently, the less precise guiding mode of Coarse Track (approximately 40 milli-arc seconds) has to be used fairly frequently. Indeed, almost half of the scientific observations to have been made with the HST will be compromised. The only realistic or extensive simulations of the Fine Lock guidance mode are reported. The theoretical analysis underlying the Monte Carlo experiments and the numerical computations clearly show both that the control electronics are severely under-engineered and how to adjust the various control parameters to successfully extend Fine Lock guiding performance back to V = 14.0 mag and sometimes beyond.
Author

N92-14090*# Computer Sciences Corp., Laurel, MD.
THE IN-FLIGHT CALIBRATION OF THE HUBBLE SPACE TELESCOPE ATTITUDE SENSORS **c89**
Gary L. Welter *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 353-381 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 03A

A detailed review of the in-flight calibration of the Hubble Space Telescope attitude sensors is presented. The review, which covers the period from the April 24, 1990, launch of the spacecraft until the time of this writing (June 1991), describes the calibrations required and accuracies achieved for the four principal attitude sensing systems on the spacecraft: the magnetometers, the fixed head star trackers, the gyroscopes, and the fine guidance sensors (FGS's). In contrast to the other three sensor groups, the Hubble Telecope's FGS's are unique in the precision and performance levels being attempted; spacecraft control and astrometric research at the near-milliarcsecond level are the ultimate goals. FGS calibration accuracies at the 20-milliarcsecond level have already been achieved, and plans for new data acquisitions and reductions that should substantially improve these results are in progress. A summary of the basic attributes of each of the four sensor groups with respect to its usage as an attitude measuring system is presented, followed by a discussion of the calibration items of interest for that group. The calibration items are as follows: for the magnetometers, the corrections for the spacecraft's static and time-varying magnetic fields; for the fixed-head star trackers, their relative alignments and use in performing onboard attitude updates; for the gyroscopes, their scale factors, alignments, and drift rate biases; and for the FGS's, their magnifications, optical distortions, and alignments. The discussion covers the procedures used for each calibration, as well as the order of the calibrations within the general flow of orbital verification activities. It also includes a synopsis of current plans for the eventual calibration of the FGS's to achieve their near-milliarcsecond design accuracy. The conclusions include a table indicating the current and predicted ultimate accuracies for each of the calibration items. Author

N92-14091*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AN EXTENDED KALMAN FILTER FOR SPINNING SPACECRAFT ATTITUDE ESTIMATION **c19**
David F. Baker *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 385-402 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

An extended Kalman filter for real-time ground attitude estimation of a gyro-less spinning spacecraft was developed and tested. The filter state vector includes the angular momentum direction, phase angle, inertial nutation angle, and inertial and body nutation rates. The filter solves for the nutating three-axis attitude and accounts for effects due to principle axes offset from the body axes. The attitude is propagated using the kinematics of a rigid body symmetric about the principle spin axis; disturbance torques are assumed to be small. Filter updates consist only of the measured angles between celestial objects (Sun, Earth, etc.) and the nominal spin axis, and the times these angles were measured. Both simulated data and real data from the Dynamics Explorer -A (DE-A) spacecraft were used to test the filter; the results are presented. Convergence was achieved rapidly from a wide range of a priori state estimates, and sub-degree accuracy was attained. Systematic errors affecting the solution accuracy are discussed, as are the results of an attempt to solve for sensor measurement angle biases in the state vector. Author

N92-14092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
QUATERNION NORMALIZATION IN ADDITIVE EKF FOR SPACECRAFT ATTITUDE DETERMINATION **c61**
I. Y. Bar-Itzhack (Technion - Israel Inst. of Tech., Haifa.), J. Deutschmann, and F. L. Markley *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 403-421 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 09B

This work introduces, examines, and compares several quaternion normalization algorithms, which are shown to be an effective stage in the application of the additive extended Kalman filter (EKF) to spacecraft attitude determination, which is based on vector measurements. Two new normalization schemes are introduced. They are compared with one another and with the known brute force normalization scheme, and their efficiency is examined. Simulated satellite data are used to demonstrate the performance of all three schemes. A fourth scheme is suggested for future research. Although the schemes were tested for spacecraft attitude determination, the conclusions are general and hold for attitude determination of any three dimensional body when based on vector measurements, and use an additive EKF for estimation, and the quaternion for specifying the attitude. Author

N92-14093*# General Sciences Corp., Laurel, MD.
COLORED NOISE EFFECTS ON BATCH ATTITUDE ACCURACY ESTIMATES
Stephen Bilanow *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 423-442 Sponsored by NASA Small Business Innovation Research Program (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

The effects of colored noise on the accuracy of batch least squares parameter estimates with applications to attitude determination cases are investigated. The standard approaches used for estimating the accuracy of a computed attitude commonly assume uncorrelated (white) measurement noise, while in actual flight experience measurement noise often contains significant time correlations and thus is colored. For example, horizon scanner measurements from low Earth orbit were observed to show correlations over many minutes in response to large scale atmospheric phenomena. A general approach to the analysis of the effects of colored noise is investigated, and interpretation of the resulting equations provides insight into the effects of any particular noise color and the worst case noise coloring for any particular parameter estimate. It is shown that for certain cases, the effects of relatively short term correlations can be accommodated by a simple correction factor. The errors in the predicted accuracy assuming white noise and the reduced accuracy due to the suboptimal nature of estimators that do not take into account the noise color characteristics are discussed. The appearance of a variety of sample noise color characteristics are demonstrated through simulation, and their effects are discussed for sample estimation cases. Based on the analysis, options for dealing with the effects of colored noise are discussed. Author

N92-14094*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
CORRELATION TECHNIQUES TO DETERMINE MODEL FORM IN ROBUST NONLINEAR SYSTEM REALIZATION/IDENTIFICATION **c64**
Greselda I. Stry and D. Joseph Mook *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 443-459 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 12A

The fundamental challenge in identification of nonlinear dynamic systems is determining the appropriate form of the model. A robust technique is presented which essentially eliminates this problem for many applications. The technique is based on the Minimum Model Error (MME) optimal estimation approach. A detailed literature review is included in which fundamental differences between the current approach and previous work is described. The most significant feature is the ability to identify nonlinear dynamic systems without prior assumption regarding the form of the nonlinearities, in contrast to existing nonlinear identification approaches which usually require detailed assumptions of the nonlinearities. Model form is determined via statistical correlation of the MME optimal state estimates with the MME optimal model

error estimates. The example illustrations indicate that the method is robust with respect to prior ignorance of the model, and with respect to measurement noise, measurement frequency, and measurement record length. Author

N92-14095*# McDonnell-Douglas Space Systems Co., Huntington Beach, CA.
MINIMUM FUEL COPLANAR AEROASSISTED ORBITAL TRANSFER USING COLLOCATION AND NONLINEAR PROGRAMMING
Yun Yuan Shi and D. H. Young *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 461-480 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

The fuel optimal control problem arising in coplanar orbital transfer employing aeroassisted technology is addressed. The mission involves the transfer from high energy orbit (HEO) to low energy orbit (LEO) without plane change. The basic approach here is to employ a combination of propulsive maneuvers in space and aerodynamic maneuvers in the atmosphere. The basic sequence of events for the coplanar aeroassisted HEO to LEO orbit transfer consists of three phases. In the first phase, the transfer begins with a deorbit impulse at HEO which injects the vehicle into a elliptic transfer orbit with perigee inside the atmosphere. In the second phase, the vehicle is optimally controlled by lift and drag modulation to satisfy heating constraints and to exit the atmosphere with the desired flight path angle and velocity so that the apogee of the exit orbit is the altitude of the desired LEO. Finally, the second impulse is required to circularize the orbit at LEO. The performance index is maximum final mass. Simulation results show that the coplanar aerocapture is quite different from the case where orbital plane changes are made inside the atmosphere. In the latter case, the vehicle has to penetrate deeper into the atmosphere to perform the desired orbital plane change. For the coplanar case, the vehicle needs only to penetrate the atmosphere deep enough to reduce the exit velocity so the vehicle can be captured at the desired LEO. The peak heating rates are lower and the entry corridor is wider. From the thermal protection point of view, the coplanar transfer may be desirable. Parametric studies also show the maximum peak heating rates and the entry corridor width are functions of maximum lift coefficient. The problem is solved using a direct optimization technique which uses piecewise polynomial representation for the states and controls and collocation to represent the differential equations. This converts the optimal control problem into a nonlinear programming problem which is solved numerically by using a modified version of NPSOL. Solutions were obtained for the described problem for cases with and without heating constraints. The method appears to be more robust than other optimization methods. In addition, the method can handle complex dynamical constraints. Author

N92-14096*# Computer Sciences Corp., Lanham, MD.
PROPELLANT-REMAINING MODELING **c12**
S. Torgovitsky *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 481-499 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22A

A successful satellite mission is predicted upon the proper maintenance of the spacecraft's orbit and attitude. One requirement for planning and predicting the orbit and attitude is the accurate estimation of the propellant remaining onboard the spacecraft. Focuss is on the three methods that were developed for calculating the propellant budget: the errors associated with each method and the uncertainties in the variables required to determine the propellant remaining that contribute to these errors. Based on these findings, a strategy is developed for improved propellant-remaining estimation. The first method is based on Boyle's law, which related the values of pressure, volume, and temperature (PVT) of an ideal gas. The PVT method is used for the monopropellant and the bipropellant engines. The second method is based on the engine performance tests, which provide data that relate thrust and specific impulse associated with a propellant tank to that tank's pressure. Two curves representing thrust and specific impulse as functions of pressure are then generated using a polynomial fit on the engine performance data. The third method involves a computer simulation of the propellant system. The propellant flow is modeled by creating a conceptual model of the propulsion system configuration, taking into account such factors as the propellant and pressurant tank characteristics, thruster functionality, and piping layout. Finally, a thrust calibration technique is presented that uses differential correction with the computer simulation method of propellant-remaining modeling. Thrust calibration provides a better assessment of thruster performance and therefore enables a more accurate estimation of propellant consumed during a given maneuver. Author

N92-14097# Technische Univ., Delft (Netherlands). Dept. of Mathematical and Physical Geodesy.
GPS: SATELLITE ORBITS AND ATMOSPHERIC EFFECTS
C. D. deJong Feb. 1991 115 p
(Rept-91-1; ETN-92-90422) Avail: NTIS HC/MF A06

Two important error sources affecting precise position determination with the Global Positioning System (GPS), namely satellite orbits and the atmosphere, are addressed. The accelerations acting on GPS satellites, numerical methods to integrate the equations of motion, and estimation of orbital and dynamic parameters are discussed. Effects on electromagnetic distance measurements to satellites caused by the atmosphere are addressed. The following topics are discussed: signal path bending, effects caused by the neutral atmosphere, ionospheric effects, modeling of atmospheric effects, estimation parameters. ESA

N92-14249*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
TRAJECTORY AND NAVIGATION SYSTEM DESIGN FOR ROBOTIC AND PILOTED MISSIONS TO MARS
S. W. Thurman and S. E. Matousek *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 113-131 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 22A

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N92-14098*# Eloret Corp., Palo Alto, CA.
PERFORMANCE ANALYSIS OF ADVANCED SPACECRAFT TPS Final Technical Report, 1 Aug. 1986 - 30 Sep. 1991
William C. Pitts 17 Dec. 1991 70 p
(Contract NCC2-434)
(NASA-CR-188694; NAS 1.26:188694) Avail: NTIS HC/MF A04 CSCL 22B

Spacecraft entering a planetary atmosphere require a very sophisticated thermal protection system. The materials used must be tailored to each specific vehicle based on its planned mission profiles. Starting with the Space Shuttle, many types of ceramic insulation with various combinations of thermal properties have been developed by others. The development of two new materials is described: A Composite Flexible Blanket Insulation which has a significantly lower effective thermal conductivity than other ceramic blankets; and a Silicon Matrix Composite which has applications at high temperature locations such as wing leading edges. Also, a systematic study is described that considers the application of these materials for a proposed Personnel Launch System. The study shows how most of these available ceramic materials would perform during atmospheric entry of this vehicle. Other specific applications of these thermal protection materials are discussed.
Author

N92-14099# Royal Signals and Radar Establishment, Malvern (England). Aerospace Div.
ANALYSIS OF THE SPACE SHUTTLE CABIN RADIATION ENVIRONMENT. PART 1: SAM GAMMA RADIATION DETECTOR RESULTS
P. R. Truscott, C. S. Dyer, A. J. Sims, and P. S. Haskins (Institute for Space Science and Technology, Inc., Gainesville, FL.) May 1991 68 p Original contains color illustrations
(RAE-TM-Space-383-Pt-1; BR304206-Pt-1; ETN-92-90702)
Copyright Avail: NTIS HC/MF A04

The result of a preliminary analysis of the gamma radiation detector experiment is presented. The experiment was part of the Shuttle Activation Monitor (SAM) flown on Shuttle mission STS-28 in August 1989. The count rates observed by the two types of detector flown (sodium iodide and bismuth germanate) are compared with the predicted variation of the cosmic ray vertical cutoff rigidity, and with the predicted trapped particle environment, based on the AP8MAX and AE8MAX models of the radiation belts. The observed count rate is found to be closely correlated with the predicted vertical cutoff rigidity. Times of expected increases in trapped radiation levels are in good agreement with the count rate enhancements observed when the spacecraft in the South Atlantic anomaly region of the high latitude outer electron belts. Higher gamma radiation levels are experienced when the detectors are in the mode shielded locations of the spacecraft. This situation is reversed for parts of the orbit when the count rates are dominated by trapped radiation. Higher rates are observed at less well shielded locations of Shuttle. South Atlantic anomaly radiation gives rise to overall enhancements in the pulse height spectra collected, indicating that trapped protons are of importance in this region.
ESA

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-14100 Illinois Univ. at Urbana-Champaign, Savoy.
BANDWIDTH-LIMITED ROBUST NONLINEAR SPACECRAFT CONTROL Ph.D. Thesis
Jinho Kim 1991 117 p
Avail: Univ. Microfilms Order No. DA9124442

Robust large-angle spacecraft pointing and tracking by variable structure control (VSC) are developed. The control of multiaxial attitude dynamics is a highly nonlinear problem, which can be resolved by exact feedback linearization with respect to attitude variables. This requires exact measurements and perfect model parameters; however, spacecraft maneuver in uncertain circumstances. Thus, robust control is required. It is shown that asymptotic stability can be achieved by VSC, provided that the parasitics are assumed be bounded. Chattering from high gains is undesirable due to actuator limit and excitation of unmodeled high frequency dynamics. Allowance of tracking errors with guaranteed bounds around attractive sliding surfaces eliminates the discontinuity caused by chattering. it is found that the trade-off study can be easily performed with actuator band-width parameters and sliding surface characteristics. Numerical simulations are conducted to validate the results. Coupled with the elastic dynamics of the structure, the angular acceleration of spacecraft excites the unmolded elastic dynamics, which also interacts with the dynamics of the whole spacecraft. While the trajectory of the controlled variable is near or at the sliding surface, the differential equations of flexible generalized amplitudes and sliding surface dynamics are derived in the state space form within the boundary layer so that the robust stability constraint can be obtained form analyzing the system matrix. It is shown that the stability of the system is determined by the following factors: modeling error, control band-width, desired target history and flexible structure configuration, and its material characteristics. Numerical simulations are performed to show that the control band-width and the sliding surface characteristic are the main factors for steady state error and stability of flexible modes. To extend the stability range and vibration suppression capability, the active damping design method with a variational principle for distributed and discrete actuators is introduced.
Dissert. Abstr.

N92-14101# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE
22 Nov. 1991 100 p Transl. into ENGLISH from various Russian articles
(JPRS-USP-91-007) Avail: NTIS HC/MF A05

This is a compilation of translated articles from Soviet publications. The general areas of discussion are as follows: manned mission highlights; space sciences; interplanetary sciences; space engineering; space applications; and space policy.

Two articles of special interest are Small Solar Sail Spacecraft for Regatta Project, and History of EPOS Air Launched Spaceplane Project. For individual titles, see N92-14102 through N92-14103.

N92-14102# Joint Publications Research Service, Arlington, VA.
SMALL SOLAR SAIL SPACECRAFT FOR REGATTA PROJECT
G. A. Avanesov and V. I. Kostenko *In its* JPRS Report: Science and Technology. USSR: Space 22 Nov. 1991 p 8-13 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 1, Jan. - Feb. 1991 p 3-8 (For primary document see N92-14101 05-18)
Avail: NTIS HC/MF A05

Details are being worked out of the Regatta project, which calls for the development of a Small Space Laboratory, for which light pressure will be used to effect attitude control and stabilization. The project's goal is the study of solar-planetary relationships (solar activity, the mechanisms for the transmission of solar effects through the interplanetary medium, and the reactions of near-planet space to solar disturbances). Author

N92-14103# Joint Publications Research Service, Arlington, VA.
HISTORY OF EPOS AIR-LAUNCHED SPACEPLANE PROJECT
Vyacheslav Kazmin *In its* JPRS Report: Science and Technology. USSR: Space 22 Nov. 1991 p 27-36 Transl. into ENGLISH from Krylya Rodiny (Moscow, USSR), no. 11, Nov. 1990 p 25-26, no. 12, Dec. 1990 p 16-17, and no. 1, Jan. 1991 p 4-5 (For primary document see N92-14101 05-18)
Avail: NTIS HC/MF A05

Both stages of an aerospace system, with a calculated mass of 115 tons, were simply attached, winged, wide-fuselage craft for horizontal takeoff and landing and multiple use. The system was designed according to a tailless lifting body design. The carrier was a 52 ton powerful aircraft booster which would accelerate to Mach 6 and separate, launching from its back at an altitude of 28 to 30 km, a 10 ton manned orbital aircraft 8 m long with a 7.4 m wing span. Only 3.4 m of this was the outer wing, and the remaining large part of the bearing surface was the width of the fuselage. This little bird was named EPOS (Experimental Manned Orbital Aircraft). It was attached to a tank of rocket fuel for insertion into orbit at hypersonic speed. The development of EPOS attracted great attention for aviation designers. Author

N92-14104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COMPUTATIONAL DETERMINATION OF BALLISTIC LIMITS FOR A SIMPLE WHIPPLE BUMPER SHIELD
E. S. Hertel, L. C. Chhabildas, L. Yarrington (Sandia National Labs., Albuquerque, NM.), and S. A. Hill 1991 10 p Presented at the Workshop on Hypervelocity Impacts in Space, Canterbury, England, 1-5 Jul. 1991
(Contract DE-AC04-76DP-00789)
(NASA-TM-105455; NAS 1.15:105455; DE92-000951; SAND-91-0876C; CONF-9107182-2) Avail: NTIS HC/MF A02 CSCL 22B

A series of numerical simulations has been performed using the multi-dimensional hydrodynamics code CTH to computationally determine a ballistic limit for a Whipple bumper shield. The ballistic limit is generally characterized as a critical diameter such that particle diameters greater than the ballistic limit will generate debris clouds that will penetrate the rear wall and particle diameters less than the ballistic limit will not. The particular shield design used for these analyses is defined as a 1.27 mm bumper, a 102 mm void space, and a 3.18 mm rear wall. Since debris shape is expected to be a contributing factor in the impact phenomena, two different shapes are considered for the numerical simulations. The particle shapes considered were flat plates of constant 1 mm thickness and varying diameters and spheres of varying diameters. The critical diameter (ballistic limit) was determined over the velocity range 4 km/s to 15 km/s for both geometries. DOE

N92-14105*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
EXPERIMENTAL AND NUMERICAL SIMULATIONS OF ORBITAL DEBRIS IMPACT ON A SIMPLE WHIPPLE BUMPER SHIELD
L. C. Chhabildas, E. S. Hertel (Sandia National Labs., Albuquerque, NM.), and S. A. Hill 1991 5 p Presented at the Workshop on Hypervelocity Impacts in Space, Canterbury, England, 1-5 Jul. 1991
(Contract DE-AC04-76DP-00789)
(NASA-TM-105456; NAS 1.15:105456; DE92-000988; SAND-91-0889C; CONF-9107182-1) Avail: NTIS HC/MF A01 CSCL 22B

A series of experiments has been performed on the Sandia HyperVelocity Launcher (HVL) to evaluate the effectiveness of thin Whipple bumper shield at impact velocities up to 10.4 km/s by orbital space debris. Upon impact by a 0.67 gm (0.87 mm thick) flier plate, the thin aluminum bumper shield completely disintegrates into a debris cloud. The debris cloud front propagates axially at velocities of approx. 14 km/s and expands radially at a velocity of approx. 7 km/s. Subsequent loading on a 3.2 mm thick aluminum substructure by the debris penetrates the substructure completely. Numerical simulations performed using the multi-dimensional hydrodynamics code CTH also predict complete penetration of the substructure by the subsequent debris cloud. DOE

N92-13988# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SPACECRAFT DYNAMICS AND CONTROL
P. C. Hughes, G. M. T. DEleuterio, G. B. Sincarsin, V. Pugliese, T. Cherpillod, K. A. Carroll, D. J. McTavish, C. J. Damaren, G. W. Crocker, and T. Hong et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 101-102 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-14088*# California Univ., Davis. Dept. of Mechanical, Aeronautical and Materials Engineering.
EFFECTIVENESS OF LARGE BOOMS AS NUTATION DAMPERS FOR SPIN STABILIZED SPACECRAFT
F. O. Eke *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 321-331 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-14080*# ST Systems Corp., Lanham, MD.
COBE GROUND SEGMENT GYRO CALIBRATION
I. Freedman, V. K. Kumar, A. Rae, R. Venkataraman, F. S. Patt, and E. L. Wright (California Univ., Los Angeles.) *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 167-185 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

N92-14087*# Rockwell Space Operations Co., Houston, TX. Guidance and Navigation Analyst.
TESTING OF THE HIGH ACCURACY INERTIAL NAVIGATION SYSTEM IN THE SHUTTLE AVIONICS INTEGRATION LAB
Russell L. Strachan and James M. Evans *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 301-320 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

N92-14091*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AN EXTENDED KALMAN FILTER FOR SPINNING SPACECRAFT ATTITUDE ESTIMATION
David F. Baker *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 385-402 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-14106*# Spectra Research Systems, Inc., Huntsville, AL. Systems Technology Div.
EVALUATION OF ADVANCED PROPULSION OPTIONS FOR THE NEXT MANNED TRANSPORTATION SYSTEM: PROPULSION EVOLUTION STUDY Final Report, Apr. 1989 - Mar. 1990
L. T. Spears and R. D. Kramer 30 Mar. 1990 150 p
(Contract NAS8-36643)
(NASA-CR-184204; NAS 1.26:184204; SRS/STD-TR89-92; Rept-6670-13) Avail: NTIS HC/MF A07 CSCL 21H

The objectives were to examine launch vehicle applications and propulsion requirements for potential future manned space transportation systems and to support planning toward the evolution of Space Shuttle Main Engine (SSME) and Space Transportation Main Engine (STME) engines beyond their current or initial launch vehicle applications. As a basis for examinations of potential future manned launch vehicle applications, we used three classes of manned space transportation concepts currently under study: Space Transportation System Evolution, Personal Launch System (PLS), and Advanced Manned Launch System (AMLS). Tasks included studies of launch vehicle applications and requirements for hydrogen-oxygen rocket engines; the development of suggestions for STME engine evolution beyond the mid-1990's; the development of suggestions for STME evolution beyond the Advanced Launch System (ALS) application; the study of booster propulsion options, including LOX-Hydrocarbon options; the analysis of the prospects and requirements for utilization of a single engine configuration over the full range of vehicle applications, including manned vehicles plus ALS and Shuttle C; and a brief review of on-going and planned LOX-Hydrogen propulsion technology activities. Author

N92-14107# Pacific Northwest Lab., Richland, WA.
PEGASUS: AN INTEGRATED POWER AND PROPULSION SYSTEM FOR THE SPACE EXPLORATION INITIATIVE
E. P. Coomes and J. E. Dagle Sep. 1991 14 p Presented at the AIAA/NASA/OAI Conference on Advanced Space Exploration Initiative (SEI) Technologies, Cleveland, OH, 3-4 Sep. 1991
(Contract DE-AC06-76RL-01830)
(DE92-000145; PNL-SA-29887; CONF-9109226-19) Avail: NTIS HC/MF A03

The advantages of using electric propulsion are well known in the aerospace community. The high specific impulse and, therefore, lower propellant requirements, make it a very attractive option for the Space Exploration Initiative (SEI). Recent studies have shown that nuclear electric propulsion (NEP) is not only attractive for the transport of cargo, but that fast-piloted missions to Mars are possible as well, with alphas on the order of 7.5 kg/Kw. An advanced NEP system with a specific power (alpha) of 2.5 kg/kW or less would significantly enhance the manned mission option of NEP by reducing the trip time even further. This paper describes an advanced system that combines the PEGASUS Drive with systems of the Rotating Multimegawatt Boiling Liquid Metal (RMBLR) power system that was developed as part of the US Department of Energy's (DOE) multimegawatt program, and was just recently declassified. In its original configuration, the PEGASUS Drive was a 10-MWe propulsion system. The RMBLR was a 20-MW electric power system. By combining the two, a second-generation PEGASUS Drive can be developed with an alpha of less than 2.5 kg/kW. This paper will address the technology advancements incorporated into the PEGASUS Drive, the analysis of a fast-piloted and unmanned cargo transport Mars mission, and the integration of laser power beaming to provide surface power. DOE

N92-14108*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LIMIT CYCLE VIBRATIONS IN TURBOMACHINERY
S. G. Ryan Dec. 1991 84 p
(NASA-TP-3181; M-676; NAS 1.60:3181) Avail: NTIS HC/MF A05 CSCL 13I

The focus is on an examination of rotordynamic systems which are simultaneously susceptible to limit cycle instability and subharmonic response. Characteristics of each phenomenon are determined as well as their interrelationship. A normalized, single mass rotor model is examined as well as a complex model of the high pressure fuel turbopump and the Space Shuttle Main Engine. Entrainment of limit cycle instability by subharmonic response is demonstrated for both models. The nonuniqueness of the solution is also demonstrated. Author

N92-14109*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-POWER HYDROGEN ARCJET PERFORMANCE
Thomas W. Haag and Francis M. Curran 1991 23 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; cosponsored by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A91-45795
(NASA-TM-105143; E-6418; NAS 1.15:105143; AIAA-91-2226)
Avail: NTIS HC/MF A03 CSCL 21H

A hydrogen arcjet was operated at power levels ranging from 5 to 30 kW with three different nozzle geometries. Test results using all three nozzle geometries are reported and include variations of specific impulse with flow rate, and thrust with power. Geometric variables investigated included constrictor diameter, length, and diverging exit angle. The nozzle with a constrictor diameter of 1.78 mm and divergence angle of 20 degrees was found to give the highest performance. A specific impulse of 1460 s was attained with this nozzle at a thrust efficiency of 29.8 percent. The best efficiency measured was 34.4 percent at a specific impulse of 1045 s. Post test examination of the cathode showed erosion after 28 hours of operation to be small, and limited to the conical tip where steady state arc attachment occurred. Each nozzle was tested to destruction. Author

N92-14110*# Honeywell, Inc., Minneapolis, MN. Systems and Research Center.
A STUDY OF MASS DATA STORAGE TECHNOLOGY FOR ROCKET ENGINE DATA Final Report
John F. Ready, Earl T. Benser, Bernard S. Fritz, Scott A. Nelson, Donald R. Stauffer, and William M. Volna Jul. 1990 121 p
(Contract NAS3-25714)
(NASA-CR-185272; NAS 1.26:185272) Avail: NTIS HC/MF A06 CSCL 21H

The results of a nine month study program on mass data storage technology for rocket engine (especially the Space Shuttle Main Engine) health monitoring and control are summarized. The program had the objective of recommending a candidate mass data storage technology development for rocket engine health monitoring and control and of formulating a project plan and specification for that technology development. The work was divided into three major technical tasks: (1) development of requirements; (2) survey of mass data storage technologies; and (3) definition of a project plan and specification for technology development. The first of these tasks reviewed current data storage technology and developed a prioritized set of requirements for the health monitoring and control applications. The second task

included a survey of state-of-the-art and newly developing technologies and a matrix-based ranking of the technologies. It culminated in a recommendation of optical disk technology as the best candidate for technology development. The final task defined a proof-of-concept demonstration, including tasks required to develop, test, analyze, and demonstrate the technology advancement, plus an estimate of the level of effort required. The recommended demonstration emphasizes development of an optical disk system which incorporates an order-of-magnitude increase in writing speed above the current state of the art.
Author

N92-14111*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ENHANCING OPTICAL ABSORPTION IN InP AND GaAs UTILIZING PROFILE ETCHING
Sheila G. Bailey, Navid S. Fatemi, and Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.) 1991 7 p Presented at the 22nd Photovoltaic Specialists Conference, Las Vegas, NV, 8-11 Oct. 1991; sponsored by IEEE
(NASA-TM-105325; E-6683; NAS 1.15:105325) Avail: NTIS HC/MF A02 CSCL 21H

The current state of profile etching in GaAs and InP is summarized, including data on novel geometries attainable as a function of etchant temperature, composition, and rate; substrate orientation; carrier concentration; and oxide thickness between substrate and photoresist. V-grooved solar cells were manufactured with both GaAs and InP, and the improved optical absorption was demonstrated. Preferred parameters for various applications are listed and discussed. Author

N92-14112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COAXIAL INJECTOR SPRAY CHARACTERIZATION USING WATER/AIR AS SIMULANTS
Michelle M. Zaller (Sverdrup Technology, Inc., Brook Park, OH.) and Mark D. Klem 1991 10 p Presented at the 28th JANNAF Combustion Meeting, San Antonio, TX, 28 Oct. - 1 Nov. 1991
(Contract NAS3-25266)
(NASA-TM-105322; E-6681; NAS 1.15:105322) Avail: NTIS HC/MF A02 CSCL 21H

Quantitative information about the atomization of injector sprays is required to improve the accuracy of computational models that predict the performance and stability of liquid propellant rocket engines. An experimental program is being conducted at NASA-Lewis to measure the drop size and velocity distributions in shear coaxial injector sprays. A phase/Doppler interferometer is used to obtain drop size data in water air shear coaxial injector sprays. Droplet sizes and axial component of droplet velocities are measured at different radii for various combinations of water flow rate, air flow rate, injector liquid jet diameter, injector annular gap, and liquid post recess. Sauter mean diameters measured in the spray center 51 mm downstream of the liquid post tip range from 28 to 68 microns, and mean axial drop velocities at the same location range from 37 to 120 m/s. The shear coaxial injector sprays show a high degree of symmetry; the mean drop size and velocity profiles vary with liquid flow rate, post recess, and distance from the injector face. The drop size data can be used to estimate liquid oxygen/hydrogen spray drop sizes by correcting property differences between water-air and liquid oxygen/hydrogen.
Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N92-14113# Massachusetts Inst. of Tech., Cambridge.
CONTROLLED SYNTHESIS OF POLYENES BY CATALYTIC METHODS
R. R. Schrock 1991 4 p
(Contract DE-FG02-86ER-13564)
(DE91-018804; DOE/ER-13564/10) Avail: NTIS HC/MF A01

A study concerned with the controlled synthesis of polyenes by ring opening metathesis polymerization using tricyclo(4.2.2.0(exp 2,5))deca-3,7,9-trienes (TCDT's) and a molybdenum catalyst (Mo(CH-t-Bu)(NAr)(O-t-Bu)(sub 2); Ar equals 2,6-C(sub 6)H3-i-Pr2) has now appeared. We have continued to search for a catalyst that will polymerize terminal acetylenes in a regiospecific manner. Recent applications of poly paraphenylenevinylenes include photo and electroluminescence. We would like to prepare poly paraphenylenevinylenes and related materials for evaluation in similar applications. DOE

N92-14114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SYNERGISTIC EFFECTS OF ULTRAVIOLET RADIATION, THERMAL CYCLING, AND ATOMIC OXYGEN ON ALTERED AND COATED KAPTON SURFACES
Joyce A. Dever, Eric J. Bruckner, and Elvin Rodriguez (Cleveland State Univ., OH.) 1992 11 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(NASA-TM-105363; E-6741; NAS 1.15:105363; AIAA-92-0794) Avail: NTIS HC/MF A03 CSCL 07A

The photovoltaic (PV) power system for Space Station Freedom (SSF) uses solar array blankets which provide structural support for the solar cells and house the electrical interconnections. In the low Earth orbital (LEO) environment where SSF will be located, surfaces will be exposed to potentially damaging environmental conditions including solar ultraviolet (UV) radiation, thermal cycling, and atomic oxygen. It is necessary to use ground based tests to determine how these environmental conditions would affect the mass loss and optical properties of candidate SSF blanket materials. Silicone containing, silicone coated, and SiO(x) coated polyimide film materials were exposed to simulated LEO environmental conditions to determine there durability and whether the environmental conditions of UV, thermal cycling and oxygen atoms act synergistically on these materials. A candidate PV blanket material called AOR Kapton, a polysiloxane polyimide cast from a solution mixture, shows an improvement in durability to oxygen atoms erosion after exposure to UV radiation or thermal cycling combined with UV radiation. This may indicate that the environmental conditions react synergistically with this material, and the damage predicted by exposure to atomic oxygen alone is more severe than that which would occur in LEO where atomic oxygen, thermal cycling and UV radiation are present together.
Author

N92-14115# Technische Univ., Delft (Netherlands). Dept. of Mathematical and Physical Geodesy.
INCLINATION FUNCTIONS: GROUP THEORETICAL BACKGROUND AND A RECURSIVE ALGORITHM
N. J. Sneeuw May 1991 109 p
(Rept-91-2; ETN-92-90423) Avail: NTIS HC/MF A06

Inclination functions to establish the link between orbit perturbations and the disturbing potential in dynamical satellite geodesy are addressed. The transformation properties of spherical harmonics are outlined. The use of group theoretical tools if an Earth fixed reference frame is rotated to the plane of the satellite orbit is discussed. Computational aspects of inclination functions are studied among methods discussed. A recursive algorithm is detailed. Its main characteristics are independent recurrences for all three indices, recurrences over degree 1 in inner loop, and stability up to high degree and order. First and second order derivatives can be provided as well. The implementation of the method in a software package, where numerical precautions were taken, tests were performed, and the use of the software is explained, is described. All subroutines are given. ESA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N92-14116 Georgia Inst. of Tech., Atlanta.
IMPROVED FINITE ELEMENT ANALYSIS OF THICK LAMINATED COMPOSITE PLATES BY THE PREDICTOR CORRECTOR TECHNIQUE AND APPROXIMATION OF C SUP 1 CONTINUITY WITH A NEW LEAST SQUARES ELEMENT Ph.D. Thesis
Jeffrey Victor Kouri 1991 215 p
Avail: Univ. Microfilms Order No. DA9124531

The use of fiber reinforced composite laminates in engineering applications has been increasing rapidly. Along with this increase has come a rapid development in the analysis techniques to accurately model internal, as well as gross plate behaviors. The purpose is to provide accurate, yet computationally efficient, improvements to the analysis of composite laminates. It is shown that the higher order extensions to the first order shear deformation theory still do not correctly model the physics of the laminated plate problem. Results show that the first order theory can provide as good, if not better, results with the proper shear correction factor. A predictor corrector technique is implemented into the finite element method to accurately calculate the shear correction factors. The technique provides excellent results with a simple Mindlin type plate element. Two new finite elements which approximate C sup 1 continuity through the use of a least squares technique is developed. These least squares elements can be used to take advantage of the displacement field simplification techniques which, up until now, have seriously complicated the finite element application. The implementation of the elements are demonstrated using a piecewise, simplified third order displacement field. The least squares elements should prove to be useful tools in any finite element application where C sup 1 continuity is required. A study into the effects of stacking sequence, boundary conditions, pre-stress, and plate aspect ratios on the fundamental frequency and buckling loads of laminated plates is presented. Dissert. Abstr.

N92-14117*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
MORPHOLOGY AND MICROSTRUCTURE OF COMPOSITE MATERIALS Progress Report, period ended 30 Jun. 1991
S. N. Tiwari and K. Srinivansan Aug. 1991 23 p
(Grant NAG1-569)
(NASA-CR-189473; NAS 1.26:189473) Avail: NTIS HC/MF A03 CSCL 11D

Lightweight continuous carbon fiber based polymeric composites are currently enjoying increasing acceptance as structural materials capable of replacing metals and alloys in load bearing applications. As with most new materials, these composites are undergoing trials with several competing processing techniques aimed at cost effectively producing void free consolidations with good mechanical properties. As metallic materials have been in use for several centuries, a considerable database exists on their morphology - microstructure; and the interrelationships between structure and properties have been well documented. Numerous studies on composites have established the crucial relationship between microstructure - morphology and properties. The various microstructural and morphological features of composite materials, particularly those accompanying different processing routes, are documented. Author

N92-14118*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTATIONAL SIMULATION OF SURFACE WAVINESS IN GRAPHITE/EPOXY WOVEN COMPOSITES DUE TO INITIAL CURING
Jose G. Sanfeliz, Pappu L. N. Murthy, and Christos C. Chamis 1992 21 p Proposed for presentation at the 37th International Symposium and Exhibit, Anaheim, CA, 9-12 Mar. 1992; sponsored by the Society for the Advancement of Material and Process Engineering
(NASA-TM-105313; E-6666; NAS 1.15:105313) Avail: NTIS HC/MF A03 CSCL 11D

Several models simulating plain weave, graphite/epoxy woven composites are presented, along with the effects that the simultaneous application of pressure and thermal loads have on their surfaces. The surface effects created by moisture absorption are also examined. The computational simulation consisted of using a two-dimensional finite element model for the composite. The properties of the finite element (FE) model are calculated by using the in-house composite mechanics computer code ICAN (Integrated Composite ANalyzer). MSC/NASTRAN is used for the FE analysis which yields the composite's top surface normalized displacements. These results demonstrate the importance of parameters such as the cure temperature (T sub o) and the resin content in the curing process of polymer-matrix composites. The modification of these parameters will help tailor the composite system to the desired requirements and applications. Author

N92-14119*# California Polytechnic State Univ., San Luis Obispo.
MATERIAL PROPERTY FOR DESIGNING, ANALYZING, AND FABRICATING SPACE STRUCTURES Final Report, 15 Nov. 1989 - 31 Dec. 1991
Faysal A. Kolkailah 31 Dec. 1991 145 p
(Grant NAG2-637)
(NASA-CR-189516; NAS 1.26:189516) Avail: NTIS HC/MF A07 CSCL 11D

An analytical study was made of plasma assisted bullet projectile. The finite element analysis and the micro-macromechanic analysis was applied to an optimum design technique for the multilayered graphite-epoxy composite projectile that will achieve hypervelocity of 6 to 10 Km/s. The feasibility was determined of dialectics to monitor cure of graphite-epoxies. Several panels were fabricated, cured, and tested with encouraging results of monitoring the cure of graphite-epoxies. The optimum cure process for large structures was determined. Different orientation were used and three different curing cycles were employed. A uniaxial tensile test was performed on all specimens. The optimum orientation with the optimum cure cycle were concluded. Author

N92-14120*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMAL CONDUCTIVITY AND THERMAL EXPANSION OF GRAPHITE FIBER/COPPER MATRIX COMPOSITES
David L. Ellis (Case Western Reserve Univ., Cleveland, OH.) and David L. McDanels 1991 19 p Presented at the Annual Meeting of The Metallurgical Society, New Orleans, LA, 17-21 Feb. 1991
(Contract NCC3-94)
(NASA-TM-105233; E-6557; NAS 1.15:105233) Avail: NTIS HC/MF A03 CSCL 11D

The high specific conductivity of graphite fiber/copper matrix (Gr/Cu) composites offers great potential for high heat flux structures operating at elevated temperatures. To determine the feasibility of applying Gr/Cu composites to high heat flux structures, composite plates were fabricated using unidirectional and cross-plied pitch-based P100 graphite fibers in a pure copper matrix. Thermal conductivity of the composites was measured from room temperature to 1073 K, and thermal expansion was measured from room temperature to 1050 K. The longitudinal thermal conductivity, parallel to the fiber direction, was comparable to pure copper. The transverse thermal conductivity, normal to the fiber direction, was less than that of pure copper and decreased with increasing fiber content. The longitudinal thermal expansion decreased with increasing fiber content. The transverse thermal expansion was greater than pure copper and nearly independent of fiber content. Author

N92-14121*# Washington Univ., Saint Louis, MO. Inst. of Technology.
HIERARCHIC MODELS FOR LAMINATED PLATES Ph.D. Thesis

Ricardo Luis Actis Dec. 1991 233 p
(Grant NAG1-639)
(NASA-CR-187827; NAS 1.26:187827) Avail: NTIS HC/MF A11 CSCL 11D

Structural plates and shells are three-dimensional bodies, one dimension of which happens to be much smaller than the other two. Thus, the quality of a plate or shell model must be judged on the basis of how well its exact solution approximates the corresponding three-dimensional problem. Of course, the exact solution depends not only on the choice of the model but also on the topology, material properties, loading and constraints. The desired degree of approximation depends on the analyst's goals in performing the analysis. For these reasons models have to be chosen adaptively. Hierarchic sequences of models make adaptive selection of the model which is best suited for the purposes of a particular analysis possible. The principles governing the formulation of hierarchic models for laminated plates are presented. The essential features of the hierarchic models described models are: (1) the exact solutions corresponding to the hierarchic sequence of models converge to the exact solution of the corresponding problem of elasticity for a fixed laminate thickness; and (2) the exact solution of each model converges to the same limit as the exact solution of the corresponding problem of elasticity with respect to the laminate thickness approaching zero. The formulation is based on one parameter (beta) which characterizes the hierarchic sequence of models, and a set of constants whose influence was assessed by a numerical sensitivity study. The recommended selection of these constants results in the number of fields increasing by three for each increment in the power of beta. Numerical examples analyzed with the proposed sequence of models are included and good correlation with the reference solutions was found. Results were obtained for laminated strips (plates in cylindrical bending) and for square and rectangular plates with uniform loading and with homogeneous boundary conditions. Cross-ply and angle-ply laminates were evaluated and the results compared with those of MSC/PROBE. Hierarchic models make the computation of any engineering data possible to an arbitrary level of precision within the framework of the theory of elasticity.
Author

N92-14122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MICROFRACTURE IN HIGH TEMPERATURE METAL MATRIX LAMINATES
Subodh K. Mital (Toledo Univ., OH.), Christos C. Chamis, and Pascal K. Gotsis 1991 26 p Presented at the 32nd Structures, Structural Dynamics, and Materials Conference, Baltimore, MD, 8-10 Apr. 1991; cosponsored by AIAA, ASME, ASCE, AHS, and ASC
(Grant NAG3-1264)
(NASA-TM-105189; E-6491; NAS 1.15:105189) Avail: NTIS HC/MF A03 CSCL 11D

Computational simulation procedures are described to evaluate the composite microfracture behavior, establish the hierarchy/sequence of fracture modes, and the influence of compliant layers and partial debonding on composite properties and microfracture initiation. These procedures are based upon three-dimensional finite element analysis and composite micromechanics equations. Typical results for the effects of compliant layers and partial debonding, microfracture initiation, and propagation and the thermomechanical cyclic loading on a SiC/Ti15 composite system are presented and discussed. The results show that interfacial debonding follows fiber or matrix fracture, and the thermomechanical cyclic loading severely degrades the composite integrity.
Author

N92-14123# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
THE DEFORMATION MODES OF CONTINUOUS FIBRE REINFORCEMENTS IN THERMOPLASTIC COMPOSITES DURING THERMOFORMING: A PRELIMINARY HIERARCHY AND GEOMETRICAL DESCRIPTION
L. M. J. Robroek Jan. 1991 35 p
(LR-654; ETN-92-90419) Avail: NTIS HC/MF A03

The use of thermoplastic composites in secondary and especially primary structures is still limited by lack of experience with the production of these composite products. More knowledge must be gained about the behavior of the material elements of the composites during thermoforming of laminates into products. The possible deformation modes of the continuous fiber reinforcement during thermoforming of a thermoplastic composite sheet are surveyed. Embedded fabric reinforcement can adjust to a product form in several ways. Movement of the composite layers relative to each other (interply phenomenon) occurs whenever the laminate is deformed. Fabric deformations can take place inside one single layer, depending on the complexity of the product to be formed. The intraply phenomena intraply shear, fiber straightening and elongation, and matrix pressure induced fiber motions are geometrically described. Some material and process variables that have important influence in the deformation potential of a composite laminate are considered. Several causes of fiber misalignment in composite products are pointed out.
ESA

N92-13965*# Academy of Sciences (USSR), Perm. Inst. of Continuous Media Mechanics.
ANALYSIS OF THE OPTIMAL LAMINATED TARGET MADE UP OF DISCRETE SET OF MATERIALS
Valery N. Aptukov and Valentin L. Belousov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 489-494 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 11D

N92-14411# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
FATIGUE OF REPAIRED COMPOSITE STRUCTURES
J. J. Gerharz, G. Danzer, and A. Maier (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F. R.) *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14412# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
INVESTIGATION ON SIZE EFFECTS OF MULTIDIRECTIONAL NOTCHED CFRP LAMINATES UNDER FATIGUE LOADING
H. C. Goetting *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14413# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
ENVIRONMENTAL FATIGUE TESTS WITH COMPOSITE MATERIALS
M. Berg, D. Rott, and H. Huth *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14415# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
CONSTITUTIVE RELATIONS FOR UD-LAYERS IN CROSSPLY LAMINATES DAMAGED BY FATIGUE LOADING
H. Eggers and H. C. Goetting *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14417# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
INTERLAMINAR DELAMINATION GROWTH OF GRAPHITE/EPOXY COMPOSITES UNDER CONSIDERATION OF CYCLIC ENERGY RELEASE RATES FOR LIFE PREDICTION
R. Prinz *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14418# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
DELAMINATION IMAGING IN CFRP LAMINATES
T. Toupin and P. Popp *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-14124# Army Tank-Automotive Command, Warren, MI.
THERMAL WAVE IMAGING EXAMPLES AND APPLICATIONS Interim Technical Report
D. N. Rose, D. C. Bryk, G. H. Quay, W. D. Jackson, and M. Parnes Jun. 1991 32 p
(AD-A240982; TACOM-13533) Avail: NTIS HC/MF A03 CSCL 14/4

This is a brief introduction to the thermal wave principle with illustrations from ongoing work performed in connection with the photoacoustic microscopy laboratory. The photoacoustic or thermal wave technique offers a unique path for evaluation of the surface and near surface thermal properties and structure of a material. An example of one micron surface resolution will demonstrate the detail available. The variety of detection approaches will be illustrated with gas-cell images; photoinductive images showing resolution 15 times better than achieved before with an eddy current imaging approach; and an image generated by an ion beam in which piezoelectric detection was used. The potential for quantifying the thickness and thermal properties of coatings will be demonstrated. Work in progress relating gas-cell images obtained with high laser intensity, which intentionally modified the surface, to subsequent x-ray measurement of residual stress will be presented. GRA

N92-14125# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
VISCOMETRY CONSTANTS FOR 1,4 POLYBUTADIENE IN TETRALIN AT 135C
M. M. Nir and R. E. Cohen 21 Oct. 1991 10 p
(Contract N00014-91-J-1045)
(AD-A241843; TR-8) Avail: NTIS HC/MF A02 CSCL 07/6

During the course of a research program on blends of crystallizable polybutadiene (PBD) isomers, we needed to determine the molecular weight of a trans 1,4 polybutadiene sample. Gel Permeation Chromatography (GPC) of the trans 1,4 PBD in 140 C tetralin was unsuccessful due to extensive polymer degradation during testing. Therefore, we obtained Mark-Houwink constants for a series of 1,4 PBD (mixed cis/trans) standards of known molecular weight and low polydispersities. The constants were determined using solutions of PBD in tetralin at 135 C, and then we obtained the Mv of the trans 1,4 PBD sample. GRA

N92-14126# Georgia Inst. of Tech., Atlanta. School of Chemistry and Biochemistry.
FUNDAMENTAL STUDIES WITH A MONODISPERSE AEROSOL-BASED LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY INTERFACE (MAGIC-LC/MS)
R. F. Browner Sep. 1991 5 p
(Contract DE-FG05-85ER-13435)
(DE91-018526; DOE/ER-13435/6) Avail: NTIS HC/MF A01

We have carried out an extensive study of the particle beam interface from several aerosol related perspectives. First, we have studied the characteristics of the aerosol as a function of the operating parameters of the nebulizer. Second, we have attempted to correlate the aerosol characteristics with the quality of the mass spectra resulting from several different classes of compounds, covering a wide range of volatility and thermal lability. DOE

N92-14127# Oak Ridge National Lab., TN.
SIMULATION STUDY OF THE SENSITIVITY OF ISOTOPE DILUTION ANALYSIS BY MASS SPECTROMETRY
C. K. Bayne Jul. 1991 63 p
(Contract DE-AC05-84OR-21400)
(DE91-018610; ORNL/CSD/TM-282; ISPO-333) Avail: NTIS HC/MF A04

Isotope dilution analysis by mass spectrometry (IDMS) is a method of measuring elemental assays or concentrations. It is especially useful when only small samples are available for the element of interest. Safeguards Analytical Laboratory (SAL) of the International Atomic Energy Agency (IAEA) at Seibersdorf, Austria, applies IDMS to measure elemental assays in uranium samples (0.5 - 10 mg) and in plutonium samples (0.001 - 5 mg). SAL makes IDMS analyses on spent fuels or nuclear products when titration methods are impractical. Chemists quantitatively mix a known amount of sample with a measured isotopic composition with a known amount of tracer of the same element as the sample. The tracer is a material with a well-known elemental concentration. Tracer material is fabricated with one or more spike isotopes whose isotopic ratios are well characterized. These tracer isotopic spikes are usually in smaller abundances (e.g., U-233, U-236, Pu-242, and Pu-244) in the sample. Chemists make mass spectrometric measurements on the resulting isotopic composition of sample and tracer mixture. The elemental assay in the sample is then calculated. These calculations compare the spike isotopic ratio in the mixture with the spike isotopic ratio in the sample using the known quantity of spike in the tracer. DOE

N92-14128# Virginia Commonwealth Univ., Richmond.
ENHANCEMENT OF FLUORESCENCE DETECTION IN CHROMATOGRAPHIC METHODS BY COMPUTER ANALYSIS OF SECOND ORDER DATA
S. C. Rutan 1991 5 p
(Contract DE-FG05-88ER-13833)
(DE91-018528; DOE/ER-13833/11) Avail: NTIS HC/MF A01

Multiwavelength detectors offer improved detection capabilities for liquid chromatographic methods, but require improvements in data analysis methodology to utilize all the available information. In this work, various methods for improving the quantitative results obtained from liquid chromatography with full spectrum fluorescence detection are being studied. The availability of multiwavelength information allows overlapped chromatographic peaks to be resolved. We are also interested in using kinetic information to aid in the resolution of overlapped responses, however, in this case, the separations are accomplished using planar separation methods, rather than column chromatographic techniques. The principles of the proposed new analytical technique to perform the desired separation using thin-layer chromatography or gel electrophoresis. DOE

N92-14129# Colorado State Univ., Fort Collins.
STUDY OF IMPROVED METHODS FOR PREDICTING CHEMICAL EQUILIBRIA
T. G. Lenz and J. D. Vaughan 1991 13 p
(Contract DE-FG02-86ER-13582)
(DE91-018803; DOE/ER-13582/5) Avail: NTIS HC/MF A03

The objective of the research during the current and preceding periods has been to calculate thermodynamic properties, (delta H degrees, delta S degrees, and delta G degrees) of typical organic reactions in the gas and solution phases with sufficient accuracy to provide a viable alternative to expensive, time-consuming laboratory experimentation. The research has proceeded along five pathways: Calculation of the thermodynamic properties delta H(sub f) degrees, C(sub p) degrees, (H degrees minus H(sub o) degrees)/T, and S degrees for reactants and products in the gas phase. Another objective is the transformation of gas phase thermodynamic properties of reactants and products into condensed phase properties by use of observed vapor pressure data. A third objective is the experimental determination of X-ray crystal structures, vapor and sublimation pressures, and calorimetric standard enthalpies of formation of large, relatively complicated reactants and products, such as Diels-Alder adducts of substituted anthracenes and substituted maleic anhydrides. The fourth objective is the experimental determination of equilibrium constants of Diels-Alder reactions of complicated strained dienes and dienophiles over a range of temperatures in liquid solution. The last objective is the molecular dynamics study of pure liquids and liquid mixtures to eventually permit new activity coefficient models being developed. DOE

N92-14130# State Univ. of New York, Binghamton.
PHOTCHEMISTRY OF INTERMOLECULAR C-H BOND ACTIVATION REACTIONS
A. J. Lees 22 Aug. 1991 4 p
(Contract DE-FG02-89ER-14039)
(DE91-018967; DOE/ER-14039/2) Avail: NTIS HC/MF A01

We have focused mainly on the solution photochemistry of the CpRh(CO2) and Cp(asterisk) Rh(CO2) (Cp equals eta (exp 5)-C5H5; Cp (asterisk) equals eta (exp 5)-C5Me5) systems. Previously, we had found that the photosubstitutional chemistry of CpRh(CO2) apparently proceeds via an associative process; this was an unexpected finding and it brought into question the assignment of a 16-electron CpRh(CO) intermediate (formed by initial CO dissociation) in these photochemical substitution and C-H bond activation reactions. In other related studies, we have been exploring the photochemical transformations taking place in a series of high nuclearity osmium cluster complexes. DOE

N92-14131# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Materials Div.
BEHAVIOR OF SPECIFIC HEAT AND SELF DIFFUSION COEFFICIENT OF SODIUM NEAR TRANSITION TEMPERATURE: A MOLECULAR DYNAMICS STUDY
Nisar Ahmed and Gulfam Khan Sep. 1990 28 p
(DE91-623616; PINSTECH/NMD-121) Avail: NTIS HC/MF A03

In this report the author used a very useful technique of simulation and applied it successfully for determining the various properties of sodium, both in liquid and solid phase near transition point. As a first step the determination of specific heat and diffusion coefficient have been carried out. In liquid state the molecular dynamics (MD) values calculated matched the experimental data. But in solid state the diffusion coefficient obtained were not consistent with the one expected for a solid, rather the values obtained suggested that sodium remained in liquid state even below the melting point. DOE

N92-14132# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.
STEADY REACTIVE STATE IN AN IRREVERSIBLE REACTION
Gulfam Khan, Y. Khawaja, and A. Sadiq Aug. 1990 18 p
(DE91-624220; PINSTECH/NPD-127) Avail: NTIS HC/MF A03

A simple two component irreversible surface reaction model introduced by Ziff, Gulari and Bershad to study the reaction of carbon monoxide with oxygen has been investigated in detail by monte carlo simulation technique. The Model predicts a first order phase transition at a carbon monoxide feed concentration (Y=0.399) and a second order phase transition at (Y=0.5255). It is found that both the coverage of carbon monoxide and oxygen as well as the production of carbon dioxide within the window described by the two critical points follows either a linear or an exponential behavior as a function of the concentration. The behavior of these quantities near the critical points is however more complicated. DOE

N92-14133# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
ASYNCHRONOUS OPTICAL SAMPLING FOR LASER-BASED COMBUSTION DIAGNOSTICS IN HIGH-PRESSURE FLAMES Annual Report, 15 Dec. 1989 - 14 Dec. 1990
Galen B. King, Normand M. Laurendeau, and Fred E. Lytle 17 Jun. 1991 15 p
(Grant AF-AFOSR-0051-89; AF Proj. 2308)
(AD-A241640; AFOSR-91-0765TR) Avail: NTIS HC/MF A03 CSCL 09/3

This report describes the progress on the development of a new laser based combustion diagnostic for the quantitative measurement of both major and minor species in high pressure flames. The technique, asynchronous Optical Sampling (ASOPS), is a state of the art improvement in picosecond pump probe spectroscopy. A method is presented for vastly improving the output of the synchronously mode-locked dye laser systems. A pump probe absorption model is used to estimate the detection limit. A new differential detector is described. A modification is made to the basic instrument to achieve shot noise limited detection. Author

N92-14134*# Alabama Univ., Huntsville. Lab. for Inline Process Analyses.
SPECTROSCOPY AND MULTIVARIATE ANALYSES APPLICATIONS RELATED TO SOLID ROCKET NOZZLE BONDLINE Final Report
W. F. Arendale, Richard Hatcher, Brian Benson, and Gary L. Workman 26 Nov. 1991 159 p
(Contract NAS8-36955)
(NASA-CR-189510; NAS 1.26:189510) Avail: NTIS HC/MF A08 CSCL 07D

Chemical composition and molecular orientation define the properties of materials. Information related to chemical composition and molecular configuration is obtained by various forms of spectroscopy. Software algorithms developed for multivariate analyses, expert systems, and Artificial Intelligence (AI) are used to conduct repetitive operations. The techniques are believed to be of particular significance toward achieving TQM objectives. The objective was to obtain information related to the quality of the bondline in the solid rocket motor, SRM, nozzle. Hysol 934 NA, a room temperature curing epoxide resin, is used as the bonding agent. A good bond requires that the adhesive be placed on a properly prepared metal surface, the adhesives Part A and B be mixed in appropriate ratio from material within shelf life specifications. Spectroscopic data was obtained for surfaces prepared according to specifications, contaminated metal surfaces, samples of the epoxide adhesive at times that represent shelf aging from 3 months to 2 years, several mix ratio of A to B, and curing material. Temperature was found to be a significant factor. The study concentrated on pot life and mix ratio. Author

N92-14135# California Univ., Berkeley. Lawrence Berkeley Lab.
SURFACE VIBRATIONAL SPECTROSCOPY OF PURE LIQUIDS
R. Superfine, J. Y. Huang, Q. Du, and Y. R. Shen Mar. 1991 5 p Presented at the 10th International Conference on Laser Spectroscopy, Font-Romeu, France, 17-21 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000843; LBL-30723; CONF-9106284-1) Avail: NTIS HC/MF A01

We report the use of infrared visible sum frequency generation (SFG) to obtain the surface vibrational spectra of pure liquid methanol and water. These are the first surface vibrational spectra ever obtained for pure liquids. We have also deduced from the SFG results the absolute orientations of molecules at the pure liquid/vapor interface. The surface methanol molecules appear to have their CH3 groups projecting out of the liquid in agreement

with the theoretical prediction. For the orientation of surface water molecules, however, different calculations have yielded very different predictions. Our SFG measurement provides clear evidence that the molecules are oriented with an unbonded hydrogen projecting out of the liquid. DOE

N92-14136# California Univ., Berkeley. Lawrence Berkeley Lab.
THE PUZZLES OF SURFACE SCIENCE AND RECENT ATTEMPTS TO EXPLAIN THEM
G. A. Somorjai Jul. 1990 30 p Presented at the 26th Yamada Conference on Surface as a New Material, Osaka, Japan, 4-6 Jul. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000928; LBL-29277; CONF-9007226-1) Avail: NTIS HC/MF A03

Surfaces have several unique properties that remain unexplained on the atomic level. These include (1) the unique chemical activity of rough surfaces, (2) the breaking of chemical bonds in narrow temperature ranges; and (3) the role of co-adsorption and strongly adsorbed monolayers during catalysis and tribological change (friction, lubrication). The dynamic surface restructuring model and surface structure induced variations in local density of states that have been suggested to rationalize the surface behavior await experimental confirmation. DOE

N92-14137# Sandia National Labs., Albuquerque, NM.
AUGER SPECTROSCOPY AND ELECTRONICALLY-STIMULATED SURFACE PROCESSES
D. R. Jennison, A. R. Burns, and E. B. Stechel 1991 19 p Presented at the 2nd International Workshop on Auger Spectroscopy and Electronic Structure, Lund, Sweden, 4-6 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000950; SAND-91-1978C; CONF-910996-1) Avail: NTIS HC/MF A03

Electronic excitations in adsorbate layers stimulate desorption and dissociation of adsorbed molecules as well as chemical reactions between adsorbates. The highest-probability stimulated processes produce neutral desorbates and determine how surface composition is altered by electron or photon radiation. A basic understanding has emerged, due largely to laser resonance-enhanced multi-photon ionization (REMPI) experiments, which provide quantum-state resolution of the gas-phase products. Auger phenomena enter this understanding in several ways. For example, core valance valance (CVV) Auger spectroscopy determines the screened hole-hole interaction (U) in adsorbates, which in turn provides insight into the degree of charge-transfer screening from the substrate. In those systems where screening charge is used in excitation Auger decay, screening directly determines the lifetime, which in turn can exponentially affect the yield. Reductions in screening, e.g. induced by coadsorption of electro-negative species, thus can result in giant yield enhancements. As separate issues, a finite U may prevent the fast resonant decay and thus increase the yield from two-hole excitations, as has been suggested for NO2) dissociation on Pt (111), or may assist in the localization (self-trapping) of two-hole excitations in dense adsorbate layers, as apparently is the case for NO desorption from the same surface. The latter causes the yields from one- and two-hole excitations to differ in their coverage dependence. Finally, CVV Auger spectroscopy, of course, measures the energies of two-hole excitations, which can be correlated with observed stimulated thresholds. DOE

N92-14138# Lehigh Univ., Bethlehem, PA.
BINDING AND CATALYTIC REDUCTION OF NO BY TRANSITION METAL ALUMINOSILICATES
K. Klier, R. G. Herman, and Shaolie Hou Sep. 1991 18 p
(Contract DE-FG22-89PC-89784)
(DE92-001657; DOE/PC-89784/8) Avail: NTIS HC/MF A03

The objective of this research is to provide the scientific understanding of processes that actively and selectively reduce NO in dilute exhaust streams, as well as in concentrated streams, to N2. Experimental studies of NO chemistry in transition metal-containing aluminosilicate catalysts are being carried out with the aim of determining the chemical rules for NO reduction on non-precious metals. The catalyst supports chosen for this investigation are A and Y zeolites, mordenite, and monoliths based on cordierite. The supported transition metal cations that were examined are principally the first row redox metals, e.g., Cr(2), Mn(II), Fe(II), Co(II), Ni(II), Cu(II), and Cu(I). The reactions of interest are the reductions of NO by H2, CO, and CH4, as well as the disproportionation of NO. Rare earth cations that possess redox properties were placed in the more shielded sites, e.g., Site I in Y zeolite, prior to or simultaneously with the exchange procedure with the transition metal cations. Theoretical calculations of the electronic structure of the transition metal cations in zeolitic sites were carried out by ab initio methods. The aim of this part of the research is to find the best match between the metal-based antibonding orbitals and the antibonding orbitals of the NO molecule such that the N-O bond is weakened and is readily broken. DOE

N92-14139# Royal Signals and Radar Establishment, Malvern (England).
A REVIEW OF POSITIVE ION SENSITIVITIES FOR THE SIMS ANALYSIS OF CMT
R. Holland and G. W. Blackmore May 1991 24 p
(RSRE-91015; BR303852; ETN-92-90691) Copyright Avail: NTIS HC/MF A03

Measurement of the relative intensities of positive ion emission from cadmium mercury telluride under Secondary Ion Mass Spectroscopy (SIMS) analysis ware performed. Data provides calibration factors for the high sensitivity analysis of impurities. The Relative Sensitivity Factor (RSF) values found, mainly from uniformly doped samples, compared well with those obtained later by other workers using implants. Theoretical models for sputtered ion emission are reviewed, and their applicability to the cadmium mercury telluride data is considered, particularly in relation to plots of log (RSF) against ionization potential. It is suggested that more than one mechanism is likely to be operative. Comparison with the results for other semiconductors suggests that the observed spread from a linear relationship might be attributable to a low implanted oxygen concentration resulting from a high sputter rate. ESA

N92-14140# Atomic Weapons Research Establishment, Aldermaston (England).
SOLUBILITY OF CALCIUM IN CaO-CaCl2
G. S. Perry and S. J. Shaw Jun. 1991 14 p
(AWE-0-16/90; BR302905; ETN-92-90705) Copyright Avail: NTIS HC/MF A03

The solubility of calcium in CaCl2-CaO melts at 800C was studied. The direct oxide reduction process is used to produce plutonium metal from plutonium dioxide by reaction with calcium. Calcium chloride is added to dissolve the calcium oxide produced, allowing the metal to coalesce into a button. Calcium metal melts at 840C and direct oxide reduction can take place below this temperature. It is likely calcium dissolved in calcium chloride reacts with the plutonium dioxide. The solubility of calcium in calcium chloride is well established, but the effect of the CaO formed during the direct oxide reduction process in the solubility of calcium was not previously determined. The solubility of calcium in calcium chloride is 2.7 mol at 800C and this is in good agreement with some literature values. Addition of calcium oxide reduces the solubility of calcium to 0.4 mol percent at 9 mol percent CaO at 800C. ESA

N92-14141# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Physics.
APPLICATIONS OF ULTRA-HIGH VACUUM TECHNIQUE TO SURFACE AND NEAR-SURFACE STUDIES Ph.D. Thesis
Jouko Lahtinen 1990 24 p Sponsored by Finnish Technology Development Center
(ETN-92-90454) Avail: NTIS HC/MF A03

The construction and characteristics of two multifunctional

Ultra High Vacuum (UHV) systems is reported. The first system is a slow positron beam apparatus for surface and near surface studies equipped with surface sensitive Auger Electron Spectroscopy (AES) and Low Electron Electron Diffraction (LEED) techniques. The system was applied to study defects induced by hydrogen implantation in silicon. The second system is a combined UHV atmospheric pressure apparatus designed for catalytic surface studies. The apparatus is equipped with X-ray photoelectron spectroscopy, thermal desorption spectroscopy, AES and LEED together with an atmospheric pressure cell within the UHV chamber for reaction experiments. This apparatus was used to study the effect of MgO on CO adsorption on Co(0001). The effect of TiO2 coverage on hydrogenation of the C-O bond on Rh foil was studied with similar equipment. ESA

N92-14142# Helsinki Univ. of Technology, Kylmaelae (Finland). Internal Combustion Engine Lab.
A STATISTICAL DETERMINATION METHOD OF CYLINDER COMBUSTION CONDITIONS USING THE CYCLIC VARIATIONS OF SOME MEASURABLE ENGINE VARIABLES
E. U. Ubong Helsinki, Finland Finnish Academy of Technology 1991 26 p
(Acta-Politec-Scand-Me-98; ISBN-951-666-325-7; ISSN-001-687X; ETN-92-90455) Avail: NTIS HC/MF A03

A statistical method of load determination and diagnosis of an abnormal condition of a multifuel spark assisted diesel engine is proposed. The method employs combustion variables and engine exogenous parameters for its deterministic model. In the model, the mean value of the air fuel ratio is considered a random variable and the angle of the onset of ignition, the angle of the maximum cylinder pressure or the maximum cylinder pressure, are considered stochastic processes associated with the random experiment. In this analysis, the engine parameters at normal operation are measured and stored in a statistical package. Since the process is a continuous during the abnormal operation, the values are compared with those at normal operation and the reason for the abnormality is discriminated. The linear regression model is used to establish the functional relationship between the response variable (air-fuel ratio) and independent variables (ignition timing, angle of the onset of ignition, and the angle of the maximum cylinder pressure). ESA

N92-13978# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
COMBUSTION AND PROPULSION
J. P. Sislian, Y. Sheng, L.-Y. Jiang, R. A. Cusworth, J. T. C. Hu, T. M. Atamanchuk, and R. Dudebout et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 65-67 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-14474# Ecole Polytechnique, Montreal (Quebec). Dept. of Mechanical Engineering.
THERMAL, THERMOCHEMICAL, AND HYBRID SOLAR HYDROGEN PRODUCTION
Ertugrul Bilgen *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 125-128 Sponsored by Natural Sciences and Engineering Research Council (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-14143# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: MATERIALS SCIENCE
31 Oct. 1991 22 p Transl. into ENGLISH of various Russian articles
(JPRS-UMS-91-008) Avail: NTIS HC/MF A03

Abstracts of Soviet publications in various areas of material science are presented. The areas covered include: corrosion, testing and analysis, ferrous metals, and nonmetallic materials. K.S.

N92-14144# Department of the Navy, Washington, DC.
ELECTROCHEMICAL NOISE MEASUREMENT TECHNIQUE FOR THE DETERMINATION OF ALUMINUM ALLOY PIT INITIATION RATES Patent Application
James E. Miller, inventor (to Navy) 28 May 1991 24 p
(AD-D015050; US-Patent-Appl-SN-708254) Avail: NTIS HC/MF A03 CSCL 11/6

This invention relates generally to electrochemical noise (ECN) and more particularly to a method of using electrochemical noise for determining pit initiation rates for an aluminum alloy. A corrosion environment is created in the aqueous solution such that a pitting reaction occurs on the surface of the aluminum alloy. Electrochemical noise produced by the resulting pitting reaction is then measured. The ECN signals are sampled, resulting in a digitized ECN signal. A fast Fourier transform (FFT) is performed on the digitized ECN signals to generate frequency spectrum amplitude data. Finally, the frequency spectrum amplitude data are converted to a log-log scale, whereby the pit initiation rate is directly proportional to the maximum-minimum spectral amplitude difference value. GRA

N92-14145# Oak Ridge National Lab., TN.
GRAIN BOUNDARY FRACTURE AND ALLOY DESIGN OF INTERMETALLICS
E. P. George and C. T. Liu 1991 9 p Presented at the 2nd Japan International Society for the Advancement of Material and Process Engineering (SAMPE) Symposium and Exhibition, Chiba, Japan, 11-14 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE91-018253; CONF-911240-2) Avail: NTIS HC/MF A02

This paper reviews recent progress in our understanding of brittle grain-boundary (GB) fracture in ordered intermetallics. Different kinds of GB brittleness are considered, including intrinsic intergranular (IG) brittleness, which in alloys like Ni3Al is the single major cause of poor ductility and brittle fracture, but in others (like NiAl and FeAl) is not the sole cause. Consequently, although boron suppresses IG fracture in all three intermetallics, it produces dramatic ductilization only in Ni3Al and not in FeAl or NiAl. Extrinsic GB brittleness is examined by considering Ni3Si, in which environmental embrittlement is a major cause of IG fracture, and the beneficial effect of boron apparently to suppression of that embrittlement. DOE

N92-14146# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
HIGH ENERGY HEAVY ION IRRADIATION EFFECT ON DEFECT STRUCTURE OF METALS
K. Khavanchak, D. Senesh, and V. A. Shchegolev 1990 16 p In RUSSIAN; ENGLISH summary
(DE91-638281; JINR-R-14-90-297) Avail: NTIS HC/MF A03

The change of yield stress has been measured on copper samples of 99.998 wt. percent purity after B, N and Ar ion irradiations with energy of 115, 227 and 433 MeV, respectively. The yield stress vs. dose curves went to saturation, according to the experimental data. A simple model is given which described the main features of the yield stress behavior after 14 MeV neutron and high energy heavy ion irradiations. The model is based upon the hypothesis, that the mobile interstitial atoms annihilate on the vacancy clusters, and this process can lead to a dynamic equilibrium in the vacancy cluster concentration. DOE

N92-14147# California Univ., Berkeley. Lawrence Berkeley Lab.
CLUSTER EXPANSION OF FCC Pd-V INTERMETALLICS
D. deFontaine, C. Wolverton, G. Ceder, and H. Dreysse (Nancy Univ., France) Jun. 1991 13 p Presented at the NATO Advanced Research Workshop, Irsee (Germany), 23-29 Jun. 1991

(Contract DE-AC03-76SF-00098)
(DE92-000842; LBL-31085; CONF-9106275-3) Avail: NTIS HC/MF A03

A cluster expansion is used to compute fcc ground states from first principles for the Pd-V system. Intermetallic structures are not assumed but derived rigorously by minimizing the configurational energy subject to linear constraints. A large number of concentration-independent interactions are calculated by the method of direct configurational averaging. Agreement with the fcc-based portion of the experimentally-determined Pd-V phase diagram is quite satisfactory. DOE

N92-14148# Lawrence Livermore National Lab., CA.
ENERGETICS AND STATISTICS OF ORDER IN ALLOYS WITH APPLICATION TO OXIDE SUPERCONDUCTORS
D. deFontaine and G. Ceder (Massachusetts Inst. of Tech., Cambridge.) Jun. 1991 13 p Presented at the European Workshop on Ordering and Disordering, Grenoble (France), 10-12 Jul. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000851; LBL-31086; CONF-9107179-1) Avail: NTIS HC/MF A03

Now that first-principles calculations of ordering transformations are becoming increasingly accurate, the deficiencies of earlier mean field methods are becoming increasingly apparent. New techniques, based on cluster expansions, are now alleviating many of the earlier problems and are producing very satisfactory results. These ideas will be illustrated for the case of oxygen ordering in the YBa2Cu3O(z) superconducting compound, for which a very simple 2-D Ising model was developed. The model features nearest-neighbor repulsive effective pair interactions and anisotropic (attractive/repulsive) next-nearest-neighbor interactions. CVM (cluster variation method) calculations based on this model have produced a phase diagram in remarkable agreement with experimentally determined phase boundaries. Monte Carlo simulations have confirmed the validity of the model and have provided a rationalization for the influence of oxygen order on the value of (Tc) (superconducting transition temperature) in off-stoichiometric compounds. DOE

N92-14149# California Univ., Berkeley. Lawrence Berkeley Lab.
DEVELOPMENT OF MICROSTRUCTURES WITH IMPROVED CRYOGENIC TOUGHNESS THROUGH LOCAL VARIATIONS IN STRESS STATE: ALUMINUM-LITHIUM ALLOYS
K. T. VenkateswaraRao and R. O. Ritchie Apr. 1990 14 p Presented at the Spring Meeting of the Materials Research Society (MRS), San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000900; LBL-28964; CONF-900466-102) Avail: NTIS HC/MF A03

Microstructurally-induced changes in the local stress state (triaxial constraint) and their effect on fracture-toughness behavior are examined at ambient and cryogenic temperatures in an Al-Li-Cu-Zr alloy, processed in the form of 12.7 mm-thick naturally laminated plate containing aligned-weak interfaces and 1.6 mm-thin unlaminated sheet. It is shown that marked improvements in long-transverse (L-T) toughness can be achieved in the plate material at cryogenic temperatures by promoting through-thickness delamination along these interfaces, which relaxes local constraint and promotes a fracture-mode transition from global plane strain to local plane stress. Conversely, in thin sheet material, the absence of such interface delamination leads to a reduction in toughness with decrease in temperature, consistent with the greater degree of crack-tip constraint. DOE

N92-14150# California Univ., Berkeley. Dept. of Materials Science and Engineering.
MICROSTRUCTURAL INFLUENCE ON THE WORK HARDENING OF ALUMINUM-LITHIUM ALLOY 2090 AT CRYOGENIC TEMPERATURES
D. Chu, C. T. Tseng, and J. W. Morris, Jr. (California Univ., Berkeley. Lawrence Berkeley Lab.) Jun. 1991 14 p Presented at the Cryogenic Engineering Conference and International Cryogenic Materials Conference, Huntsville, AL, 11-14 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000903; LBL-31075; CONF-910635-17) Avail: NTIS HC/MF A03

Previous studies indicate that the work hardening characteristics of a Vintage III 2090-T81 12.7-mm (0.5-in.) plate is highly dependent on the through-thickness position. This dependency has been linked to two distinctly different microstructures existing as laminates within the plate. An investigation of the two microstructures by both optical and transmission electron microscopy reveal a difference in the distribution of grains and subgrains. It is believed that these factors affect the work hardening characteristics by governing the manner in which slip is transmitted from grain to grain. The findings are positive as they suggest a practical means by which improvements in work hardening can be obtained through modifications of the microstructure at the polygranular level. DOE

N92-14151# California Univ., Berkeley. Lawrence Berkeley Lab.
ON THE MICROMECHANISMS OF FATIGUE-CRACK PROPAGATION IN ALUMINUM-LITHIUM ALLOYS: SHEET VS PLATE MATERIAL
K. T. RaoVenkateswara, R. O. Ritchie, and R. J. Bucci (Aluminum Co. of America, Alcoa Center, PA.) Dec. 1989 10 p Presented at the Fatigue 1990: 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, 15-20 Jul. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000926; LBL-28244; CONF-900764-4) Avail: NTIS HC/MF A02

Micromechanisms influencing the propagation of long (greater than 10 mm) fatigue cracks in aluminum-lithium alloys are examined by specifically comparing crack-growth kinetics in a peak-aged Al-Li-Cu-Zr alloy 2090, processed as 1.6-mm thin (T83) sheet and 12.7-mm thick (T81) plate. It is found that in general crack-growth rates are significantly faster in the sheet material at equivalent stress-intensity levels, due to differences in the role of crack-tip shielding, resulting from crack deflection and consequent crack closure from wedging of fracture-surface asperities. Microstructurally, such differences are related to variations in the degree of recrystallization, grain structure, and deformation texture in the two wrought-product forms. DOE

N92-14152# California Univ., Berkeley. Lawrence Berkeley Lab.
INFLUENCE OF EXTRINSIC CRACK DEFLECTION AND DELAMINATION MECHANISMS ON THE CRYOGENIC TOUGHNESS OF ALUMINUM-LITHIUM ALLOY 2090: BEHAVIOR IN PLATE (T81) VS SHEET (T83) MATERIAL
K. T. VenkateswaraRao and R. O. Ritchie Feb. 1989 15 p Presented at the 5th International Aluminum-Lithium Conference, Williamsburg, VA, 28-31 Mar. 1989
(Contract DE-AC03-76SF-00098)
(DE92-000927; LBL-26928; CONF-8903109-6) Avail: NTIS HC/MF A03

Cryogenic strength-toughness relationships are examined in 1.6-mm-thick sheet of commercial 2090-T8 aluminum-lithium alloy, and results are compared with behavior in 12.7-mm-thick rolled plate. Unlike the significant increase in L-T fracture toughness exhibited by thick place sections at cryogenic temperatures, the thin sheet (of normally similar composition and microstructure) shows a marked decrease in toughness between 298 and 77 K. Such contrasting observations are attributed primarily to the low short-transverse toughness of the 2090-plate material, which results in enhanced through-thickness intergranular splitting during low-temperature fracture and hence to a prominent role of crack-divider delamination toughening. DOE

N92-14153# Sandia National Labs., Albuquerque, NM.
HIGH TEMPERATURE NITROGEN IMPLANTATION OF Ti-6Al-4V
F. M. Kustas, M. S. Misra, R. Wei, P. J. Wilbur (Colorado State

Univ., Fort Collins.), and J. A. Knapp 1991 18 p Presented at the 7th International Conference on Surface Modification of Metals by Ion Beams (SMMIB-7), Washington, DC, 15-19 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-018678; SAND-91-1963C; CONF-910707-7) Avail: NTIS HC/MF A03

Titanium alloys offer desirable properties that make them attractive candidates for tribological applications. Their surface-related properties, however, such as coefficient of friction and wear rate, are less than optimum and must be improved by surface modification. To increase the tribological properties of Ti-6Al-4V, a high temperature ion implantation method, employing a high current density beam (e.g., 500 microA/sq cm) of nitrogen (N) ions is being developed, where surface temperatures greater than 1000 C can be obtained. A systematic study was performed with N implantation at temperatures from 400 to greater than 1000 C, and to a range of doses from 0.1 to 1.0 x 10(exp 18) N2(+) to N(+)/sq cm. Microstructure characterization by Rutherford Backscattering Spectroscopy (RBS) and Glancing Incidence X ray Diffraction (GID) was performed to determine N distribution and compound formation. RBS analysis showed enhanced N penetrations (i.e., greater than 0.3 micron for the 800 and 1000 C implantations, with the deepest penetration (about 3.5 atomic percent N remaining at 0.75 micron for the 1000 C treatment. GID indicated TiN and Ti2N concentrations were the greatest for the 800 C implantation treatment. DOE

N92-14154# Oak Ridge National Lab., TN.
USE OF MINIATURE AND STANDARD SPECIMENS TO EVALUATE EFFECTS OF IRRADIATION TEMPERATURE ON PRESSURE VESSEL STEELS
F. M. Haggag, R. K. Nanstad, and S. T. Byrne 1991 7 p Presented at the 5th International Symposium on Environmental Degradation on Materials in Nuclear Power Systems - Water Reactors, Monterey, CA, 25-29 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE91-018849; CONF-910808-5) Avail: NTIS HC/MF A02

The effects of neutron irradiation on the steel reactor vessel for the modular high-temperature gas-cooled reactor (MHTGR) are being investigated, primarily because the operating temperatures are low (121 to 210 C) compared to those for commercial light-water reactors (LWRs) (approximately 288 C). The need for design data on the reference temperature shift necessitated the irradiation at different temperatures of A 533 grade B class 1 plate. A 508 class 3 forging, and welds used for the vessel shell, vessel closure head, the vessel flange. This paper presents results from the first four irradiation capsules of this program. The four capsules were irradiated in the University of Buffalo Reactor to an effective fast fluence of 1 times 10(exp 18) neutron/cm(exp 2) (0.68 times 10(exp 18) neutron/cm(exp 2) (greater than 1 MeV)) at temperatures of 288, 204, 163, and 121 C, respectively. The yield and ultimate strengths of both steel plate materials of the MHTGR Program increased with decreasing irradiation temperature. Similarly, the 41-J Charpy V-notch (CVN) transition temperature shift increased with decreasing irradiation temperature (in agreement with the increase in yield strength). The miniature tensile and automated ball indentation (ABI) test results (yield strength and flow properties) were in good agreement with those from standard tensile specimens. The miniature tensile and ABI test results were also used in a model that utilizes the changes in yield strength to estimate the CVN ductile-to-brittle transition temperature shift due to irradiation. The model predictions were compared with CVN test results obtained here and in earlier work. DOE

N92-14155# California Univ., Berkeley. Lawrence Berkeley Lab.
DISTRIBUTION OF ION-IMPLANTED YTTRIUM IN Cr2O3 SCALE AND IN THE UNDERLYING Ni-25 WT PERCENT Cr ALLOY
P. Y. Hou, I. Brown, and V. Chia (Evans, Charles and Associates, Redwood City, CA) Jul. 1991 19 p Presented at the 7th International Conference on Surface Modification of Metals by Ion Beams (SMMIB-7), Washington, DC, 15-19 Jul. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000734; LBL-31008; CONF-910707-8) Avail: NTIS HC/MF A03

Implantation of yttrium and other reactive metals has been known to show significant effects on the oxidation behavior of Cr2O3 forming alloys. The oxide growth rate decreases by nearly a factor of ten, and the adhesion of oxide scales to alloys is greatly improved. To better understand the mechanisms by which these elements affect oxidation, it is important to know whether or not they are present in the metal ahead of the oxide layer. In this study, the diffusivity of implanted yttrium in a Ni-25Cr alloy and its distribution in the oxide scale after different oxidation times have been evaluated using secondary ion mass spectroscopy. It was found that only 17 ppm of yttrium was left in the alloy after just 20 minutes of oxidation at 1000 C. The implanted Y remained concentrated at the oxide/gas interface as the oxide thickened with time. Within the oxide layer, the Y concentration progressively dropped to zero at the scale/alloy interface. These results are discussed in relation to several important mechanisms proposed for the beneficial effects of reactive element additions on scale adhesion. DOE

N92-14156# Sandia National Labs., Albuquerque, NM.
FUNDAMENTALS OF METALS JOINING WITH LASERS
J. L. Jellison 1991 7 p Presented at the Fall Meeting of the Minerals, Metals, and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000789; SAND-91-0032C; CONF-911003-17) Avail: NTIS HC/MF A02

The intrinsic characteristic of a laser as a metals joining heat source is high intensity (high irradiance). Other advantages stem from the ability to optically manipulate the beam and the inertness of light. Optimal application of laser technology to metals joining is supported by a fundamental understanding of the physics of the process. The interaction of the laser beam with metals is highly materials and process dependent. Metals joining with lasers in a absence of an understanding of beam-materials interactions would appear to be a highly unpredictable process. This is because of the complexity of beam-material interactions. For example, absorptivity varies by more than an order of magnitude as a function of alloy, temperature, oxide thickness, and laser wavelength. Also, in most laser welding and brazing processing, evaporation of metal creates a significant plume, and beam-plume interactions can markedly alter the spatial distribution of energy at the plume-metal interface. The probability of the beam being absorbed by the plume increases with the square of the wavelength, whereas the propensity for scattering of the beam by particles in the beam is inversely proportional to wavelength. Also, the beam can be refracted due to thermal and compositional gradients in the plume. In selecting a laser process for a given application, understanding each of these physical effects and others is helpful. In many ways, the physics of metals joining with lasers is only qualitatively understood at the present time. This paper overviews the present understanding of the process and identifies areas where research is required to clarify our process understanding. DOE

N92-14157# California Univ., Berkeley. Lawrence Berkeley Lab.
THEORY OF ORDERING TRANSFORMATIONS IN METALS AND MINERALS Ph.D. Thesis
T. F. Lindsey (California Univ., Berkeley.) Jul. 1991 107 p
(Contract DE-AC03-76SF-00098)
(DE92-000855; LBL-31057) Avail: NTIS HC/MF A06

This dissertation presents an investigation of ordering in FCC based systems using the pair potential approximation in the ground state and mean field limits. The theoretical approach is used to explain the occurrence of observed equilibrium phases and characteristics of thermodynamic instabilities, in particular, spinodal ordering and decomposition. It is shown that the stability of non-integer domain sizes in long period superstructures such as

Al3Ti and Ag3Mg may result from the tendency of a system to reduce the number of non-dominant ordering waves, thus producing domain sizes that have rational fraction form n/m. This conclusion is used to explain the domain size stability with respect to variations in temperature and electron concentration. The cation ordering in the precipitate phases in calcite and dolomite is analyzed by analogy with ordering in FCC based metals. The ordered phases in calcite and dolomite are shown to be consistent with pair potential minima at (100) and (1/2, 1/2, 1/2) positions in reciprocal space respectively. DOE

N92-14158# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Nuclear Physics Div.
SEGREGATION IN WELDED NICKEL-BASE ALLOYS
J. I. Akhtar, K. A. Shoaib, M. Ahmad, and M. A. Shaikh May 1990 18 p
(DE91-624373; PINSTECH/NPD-126) Avail: NTIS HC/MF A03

Segregation effects have been investigated in nickel-base alloys Monel 400, Inconel 625, Hastelloy C-276 and Incoloy 825, test welded under controlled conditions. Deviations from the normal composition have been observed to varying extents in the welded zone of these alloys. Least effect of this type occurred in Monel 400 where the content of Cu increased in some of the areas. Enhancement of Al and Ti has been found over large areas in the other alloys which has been attributed to the formation of low melting slag. Another common feature is the segregation of Cr, Fe or Ti, most likely in the form of carbides. Enrichment of Al, Ti, Nb, Mb, Mo, etc., to different amounts in some of the areas of these materials is interpretted in terms of the formation of gamma prime precipitates or of Laves phases. DOE

N92-14159# Sandia National Labs., Albuquerque, NM.
THE EFFECT OF Cu AT Al GRAIN BOUNDARIES ON ELECTROMIGRATION BEHAVIOR IN Al THIN FILMS
D. R. Frear, J. R. Michael, A. D. Romig, Jr., C. Kim, and J. W. Morris, Jr. (California Univ., Berkeley.) 1991 11 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Technical Conference and Exhibition on Microelectronic Integrated Processing, San Jose, CA, 15-20 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-018677; SAND-91-1922C; CONF-910904-1) Avail: NTIS HC/MF A03

The distribution of copper aluminum thin films is examined with respect to how the copper can influence electromigration behavior. Al-Cu thin films annealed in the single phase region, to just below the solvus theta-phase Al2Cu precipitates at the aluminum grain boundaries. The grain boundaries between precipitates are depleted in copper. Al-Cu thin films heat treated at lower temperatures, within the two phase region, also have theta-phase precipitates at the grain boundaries, but the aluminum grain boundaries continuously become enriched in copper, perhaps due to the formation of a thin coating of theta-phase at the grain boundary. Here, it is proposed that electromigration behavior of aluminum is improved by adding copper because the theta-phase precipitates may hinder aluminum diffusion along the grain boundaries. It was also found that resistivity of Al-Cu thin films decreases during accelerated electromigration testing prior to failure. Pure Al films did not exhibit this behavior. The decrease is resistivity is attributed to the redistribution of copper from the aluminum grain matrix to the theta-phase precipitates growing at the grain boundaries, thereby reducing the number of defects in the microstructure. DOE

N92-14160# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
VANADIUM AND TANTALUM FREQUENCY SPECTRUM DEFORMATION BY INTERSTITIAL IMPURITIES [DEFORMATSIYA SPEKTROV CHASTOT VANADIYA I TANTALA PRIMESYAMI VNEDRENIYA]
S. A. Danilkin and V. P. Minaev 1988 9 p In RUSSIAN
(DE91-623605; FEI-1903) Avail: NTIS HC/MF A02

Results of calculating metal atom oscillation spectra in disordered solid solutions vanadium-oxygen, vanadium-nitrogen and tantalium-nitrogen in virtual crystal model are presented in the work. It is shown that under nitrogen and oxygen atom implantation frequency distribution deformation takes place: atom oscillation spectrum features and boundary frequency are shifted to the region of higher frequencies by 0.5 to 1.0 MeV as compared to source metal spectra. The spectrum frequency mean square increases by 3 to 9 pct. in the phases indicated. Calculation results qualitatively agree with the experimentally observed changes in vanadium and tantalum frequency spectra caused by implanted atoms. DOE

N92-14161# Argonne National Lab., IL.
A NOVEL PHASE TRANSITION IN ALLOYS
M. L. Saboungi and D. L. Price Sep. 1991 17 p Presented at the 5th International Conference on the Structure of Non-Crystalline Materials, Sendai, Japan, 2-6 Sep. 1991
(Contract W-31-109-eng-38)
(DE92-000366; ANL/CP-74212; CONF-9109103-2) Avail: NTIS HC/MF A03

The intermediate-phase of the intermetallic alloy CsPb is shown to be a plastic crystal characterized by jump reorientations of Cs4Pb4 structural units. The wave vector variation of elastic and quasielastic intensities is well reproduced by a simple model if independent structural units jump between the four orientations observed in the crystal at room temperature. This represents the first observation of a plastic crystal phase in a metal alloy. DOE

N92-14162# Northwestern Univ., Evanston, IL. Dept. of Materials Science and Engineering.
STUDY OF MECHANICAL BEHAVIOR AND INTERNAL STRUCTURE OF FERRITIC NANOCRYSTALLINE MATERIAL
J. R. Weertman and W. P. Murphy Aug. 1991 23 p
(Contract DE-FG02-86ER-45229)
(DE92-000760; DOE/ER-45229/24) Avail: NTIS HC/MF A03

The research thrust of this grant has been directed into two areas. The principal effort has been spent in an investigation of the synthesis, mechanical behavior and internal structure of ferritic nanocrystalline material. A second effort involves a study of the high temperature behavior of several ferritic steels. In particular, we are investigating the precursors and earliest stages of fatigue crack initiation, especially how initiation is affected by hold times and by environment. DOE

N92-14163# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
SLIP, TWINNING AND TRANSFORMATION IN LAVES PHASES
S. M. Allen 10 Apr. 1991 14 p
(Contract DE-FG02-90ER-45426)
(DE92-000764; DOE/ER-45426/1) Avail: NTIS HC/MF A03

Intermetallic compounds are currently being widely studied as potential high-temperature structural materials. Most of these studies are on phases such as Ni3Al, TiAl, NiAl, and Ti3Al, hich have structures that are crystallographic derivatives of fcc, bcc, or hcp structures. However, most intermetallics have more complex crystal structures, and little is known about their deformation mechanisms and mechanical properties. By far the largest class of such compounds is that of the Laves phases, AB2 compounds having three different crystal structures: C15(cubic), C14 (hexagonal), and C36 (dihexagonal). An earlier DOE-sponsored study entitled, Deformation and Defects in Laves Phases, explored the high-temperature deformation of cubic and hexagonal Laves phases, room-temperature deformation of two-phase V-Hf-Nb alloys containing substantial amounts of Laves phase, and, by electron microscopy, the deformation-induced defects in these alloys. The present study builds on these earlier results, and has as its general goal an improved understanding of the factors influencing ductility and toughness of Laves phases, particularly at room temperature. DOE

N92-14164# Lawrence Livermore National Lab., CA.
CYCLIC FATIGUE-CRACK PROPAGATION IN CERAMICS: LONG AND SMALL CRACK BEHAVIOR
A. A. Steffen, R. H. Dauskardt, and R. O Ritchie (California Univ.,

Berkeley. Lawrence Berkeley Lab.) Dec. 1989 13 p Presented at the Fatigue '90: 4th International Conference on Fatigue and Fatigue Thresholds, Honolulu, HI, 15-20 Jul. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000899; LBL-28243; CONF-900764-3) Avail: NTIS HC/MF A03

Stress/life (S/N) and cyclic fatigue-crack growth properties are studied in a Mg-PSZ, with particular reference to the role of crack size. S/N data from unnotched specimens show markedly lower lives under tension-compression compared to tension-tension loading; fatigue limits (at 10(exp 8) cycles) for the former case approach 50 percent of the tensile strength. Under tension-tension loading, cyclic crack-growth rates of long (less than 3 mm) cracks are found to be power-law dependent on the stress-intensity range (Delta)K with a fatigue threshold, (Delta)K(sub TH), of order 50 percent K(sub c). Conversely, naturally-occurring small (1 to 100 micron) surface cracks were observed to grow at (Delta)K levels some 2 to 3 times smaller than (Delta)K(sub TH). The implications of such data for structural design with ceramics is briefly discussed. DOE

N92-14165# Sandia National Labs., Albuquerque, NM.
SEQUENTIAL DEPOSITION ETCH TECHNIQUES FOR THE SELECTIVE DEPOSITION OF TUNGSTEN
J. G. Fleming, T. R. Omstead, and F. Dominguez 1991 7 p Presented at the 1991 Tungsten Workshop, Murray Hill, NJ, 8 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000953; SAND-91-2229C; CONF-9110240-1) Avail: NTIS HC/MF A02

We report on the use of a deposition/etch approach to the loss of selectivity problem, using high activity fluorine chemistries in the etch step. Proof-of-concept experiments were initially performed in a hot wall system; the excellent results obtained lead us to prove out the concept in a commercially available cold wall Genus reactor. We observed that WF6 is ineffective as an etchant of W. The technique has been able to produce perfectly selective depositions 1 micron thick in both hot wall, and cold wall, systems. Sheet resistivity values and film morphology are good. DOE

N92-14166# Royal Aerospace Establishment, Farnborough (England). Aerospace Div.
SPECIMENS FOR FATIGUE AND FRACTURE EVALUATION OF METALS: FRAG RECOMMENDATIONS (FIRST ISSUE)
R. Cook 16 Apr. 1991 48 p
(RAE-TR-91025; RAE-Mat/Str-312; BR303318; ETN-92-90701)
Copyright Avail: NTIS HC/MF A03

Specimens commonly used to generate fatigue and fracture data are reviewed, and specimens to be used in the future for a wide range of test purposes are recommended. A selected number of laboratory specimens, which are recommended for future use in fatigue and fracture testing of metallic materials and joint configurations, is given. A small group of core specimens, which should be prereferentially chosen when assessing the fatigue and fracture qualities of a particular material or of particular structural feature, is defined. Guidelines are given on dimensional changes which may be needed for specific requirements. Advice on specimen manufacture and assembly methods is provided. ESA

N92-14167 National Physical Lab., Teddington (England). Div. of Materials Metrology.
A REVIEW OF ECSC-FUNDED RESEARCH ON MOULD POWDERS
K. C. Mills Aug. 1990 93 p
(NPL-DMM(A)-10; ISSN-0143-7313; ETN-92-90712) Copyright Avail: National Physical Lab., Teddington, TW11 OLW, England

A state of the art review of research on mould powders is presented. The European Coal and Steel Community (ECSC) funded seventeen research projects concerned with the performance of mould powders in the continuous casting of steel. The significant advances made in these projects made a marked contribution to current knowledge; the principal findings of these research programs are outlined. The requirements for a successful performance of a powder, in order to avoid inferior surface quality or sticker breakout, are given. The investigations show that sticker breakouts occur when a carbonaceous agglomerate simultaneously blocks the flow of liquid slag into the mould strand gap and carburizes the meniscus to produce a shell which does not heal during negative strip periods. ESA

N92-14168# European Space Agency, Paris (France).
STUDY AND MODELLING OF THE MECHANICAL BEHAVIOUR OF A NICKEL-BASE SINGLE CRYSTAL SUPERALLOY FOR TURBINE BLADE
Philippe Poubanne (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Jul. 1991 271 p
(ESA-TT-1180; ONERA-NT-1989-5; ETN-92-90739) Avail: NTIS HC/MF A12

The experimental survey characterizes the mechanical anisotropy in several ways: elasticity, flow stress, initial hardening, and induced hardening, under both monotonic anbd cyclic uniaxial loading. Microscopic mechanisms of plastic deformation are studied (with optical and transmission electron microscopy) in order to gain a better understanding of the complex mechanical response of the material observed experimentally. A review of the literature on the various models for the behavior of anisotropic bodies is made and two particular modeling levels are selected and developed: the first lies within the context of the mechanics of continuous media and is based on theories involving tensor function representations; and the second takes into account experimental observations by introducing slip systems and describes the effects of microscopic mechanisms through internal phenomenological variables. This model can simulate experimental results quite well and is a basic tool for the simulation of multiaxial loading. ESA

N92-14402# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
MECHANICAL PROPERTIES OF PM ALUMINIUM ALLOYS
R. Schaefer *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14403# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
INFLUENCE OF POROSITY ON FATIGUE BEHAVIOUR OF CAST ALUMINIUM ALLOYS
C. M. Sonsino and K. Dieterich *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14404# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
IMPROVEMENT OF FATIGUE BEHAVIOUR OF SINTERED STEELS BY SURFACE ROLLING
C. M. Sonsino and F. Mueller *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14406# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
LCF-BEHAVIOUR OF TURBINE STEELS UNDER CREVICE CORROSION CONDITIONS
E. Lachmann *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

N92-14410# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
FRACTURE TOUGHNESS AND CRACK PROPAGATION BEHAVIOUR OF ALUMINIUM 2219 T87

A. Schoepfel, O. Peter, and W. Koehler (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-14169# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
PHOSPHAZENE POLYMER MEMBRANES: HAZARDOUS CHEMICAL REMOVAL FROM GAS AND LIQUID FEEDSTREAMS
Mark L. Stone, Erik S. Peterson, Melvin D. Herd, Daniel G. Cummings, and Robert R. McCaffrey (Ciba-Corning Diagnostics, Medfield, MA.) 1991 7 p Presented at the International Conference on Effective Industrial Membrane Processes, Benefits and Opportunities, Edinburgh, Scotland, 19-21 Mar. 1991
(Contract DE-AC07-76ID-01570)
(DE91-013217; EGG-M-90406; CONF-9103177-1) Avail: NTIS HC/MF A02

Phosphazene polymers consist of nitrogen-phosphorus backbones which have high thermal and chemical stabilities. Experiments at the Idaho National Engineering Laboratory demonstrate that phosphazene polymer membranes are capable of removing: (1) chlorinated hydrocarbons from water and air; and (2) acid gases such as SO2, from nitrogen. These results point to a wide range of potential industrial and environmental applications. DOE

N92-14170*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROPERTIES OF NOVEL CVD GRAPHITE FIBERS AND THEIR BROMINE INTERCALATION COMPOUNDS
James R. Gaier, Max L. Lake, Alia Moinuddin, and Mark Marabito (Cleveland State Univ., OH.) 1991 10 p Presented at the 20th Biennial Conference on Carbon, Santa Barbara, CA, 23-28 Jun. 1991; sponsored by the American Carbon Society
(NASA-TM-105295; E-6595; NAS 1.15:105295) Avail: NTIS HC/MF A02 CSCL 11C

A hybrid fiber with a PAN core surrounded by a vapor grown carbon fiber (VGCF) sheath was fabricated using a proprietary process. The density, ultimate tensile strength, Young's modulus, and resistivity of pristine and bromine intercalated fibers made by this technique having diameters varying from 5 to 50 microns were compared with the values predicted from the rule of mixtures model. For both the pristine and intercalated fibers, the density, ultimate tensile strength, and Young's modulus of the fibers were lower than predicted, but the resistivity was measured to be consistent with predictions. The lower than theoretical mechanical properties may be evidence of a low density disordered interface between the core and the sheath which would lower the density and degrade the mechanical properties, but would leave the resistivity nearly unaffected. Intercalation had little if any effect on the ultimate tensile strength and Young's modulus, but raised the density by about 11 pct., and lowered the resistivity by an order of magnitude. The diameter dependence of the resistivity showed evidence of a depletion layer of the type found in VGCF. Author

N92-14171# General Sciences Corp., Souderton, PA.
SELF-PROPAGATING REACTIONS FOR SYNTHESIS OF HIGH TEMPERATURE MATERIALS Final Report, Nov. 1987 - Mar. 1989
Michael A. Riley, Peter D. Zavitsanos, and Joseph J. Gebhardt Apr. 1991 33 p
(Contract DAAL04-87-C-0083)
(AD-A241660; MTL-TR-91-14) Avail: NTIS HC/MF A03 CSCL 11/2

Hard ceramics including TiB2, produced by conventional methods such as sintering and hot pressing require expensive high temperature process steps and machining which add significant cost to the material. The use of exothermic, self-propagating reactions (SHS), have recently received interest especially by the Soviet to form high purity refractory compounds especially in the boride and carbide systems. The cost effective production of abrasive compounds, cutting tools and high hardness monolithic, refractory materials has been claimed. The SHS process, at its basic level, involves the intimate blending of elemental powders at stoichiometric levels (in this case titanium and boron). Once blended, the materials are pressed into monolithic shapes and heated at one point to a reaction temperature (700 to 1200 C). Upon achieving the reaction temperature, the remaining body is transformed via self-propagating thermal wave into intermetallic or ceramic body based upon the original binary mixture (Ti + 2B yields TiB2). Lightweight ceramics which can be prepared by SHS reactions are being considered as candidates for armor. Limited testing to date has identified the generic properties which can maximize armor performance. GRA

N92-14172# Arizona Univ., Tucson.
CERAMICS DERIVED FROM ORGANO-METALLIC PRECURSORS Final Technical Report, 1 Apr. 1988 - 31 Mar. 1991
Donald R. Uhlmann Oct. 1991 155 p
(Contract F49620-88-C-0064)
(AD-A241849; AFOSR-91-0887TR) Avail: NTIS HC/MF A08 CSCL 07/4

Work carried out under the present grant was directed principally to the wet chemical synthesis of various oxide ceramics in film, fiber and powder forms. These include (1) chemical synthesis of high temperature oxide superconductors, the formation of glasses of such superconductors, their subsequent crystallization behavior, and the wet chemical synthesis of barrier layers for use with superconducting thin films; (2) ceramic-organic hybrid composites (POLYCERAMS); (3) synthesis and dielectric properties of POLYCERAMS (4) novel optical materials comprising of non-linear organic dyes in POLYCERAM hosts; (5) wet chemical coating of fibers for composites and synthesis of bulk transformation - toughened ceramics; (6) seeded transformation of alumina gels from different precursors; (7) ferroelectric powders, films and fibers; and (8) second harmonic generation from ferroelectric thin films. GRA

N92-14173# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
CRITICAL BEHAVIOUR OF Y-Ba-Cu-O HTSC-CERAMICS UNDER IRRADIATION BY REACTOR NEUTRONS
B. A. Borisov, V. A. Evseev, R. F. Konopleva, and V. A. Chekanov 1990 15 p In RUSSIAN; ENGLISH summary
(DE91-636999; LIYaF-1602) Avail: NTIS HC/MF A03

The studies of resistive transitions into superconducting state for T greater than T(sub c) of HTSC-ceramics Y-Ba-Cu-O initial and irradiated by fluence up to 3.8 x 10(exp 18) cm(exp -2) of reactor neutrons are carried out. The analysis of the experimental data is based on percolation theory. A value of critical exponents conductivity t of percolation theory is determined from the experimental data in assumption of proportionality temperature scale to volume one occupied by superconducting fraction. DOE

N92-14174# Pacific Northwest Lab., Richland, WA.
TESTING OF ADVANCED CERAMIC FABRIC HEAT PIPE FOR A STIRLING ENGINE
Z. I. Antoniak, B. J. Webb, and J. M. Bates Sep. 1991 4 p Presented at the AIAA/NASA/OAI Conference on Advanced SEI Technologies, Cleveland, OH, 3-4 Sep. 1991 Previously announced in IAA as A91-52421
(Contract DE-AC06-76RL-01830)
(DE92-000142; PNL-SA-19728; CONF-9109226-16) Avail: NTIS HC/MF A01

The development and application of Stirling engines for space power production requires concomitant development of an advanced heat rejection system. We are currently involved in the design, development, and testing of advanced ceramic fabric (ACF) water heat pipes for optimal heat rejection from the Stirling cycle without the use of hazardous working fluids such as mercury. Our testing to-date has been with a 200 micron thick titanium heat pipe utilizing Nextel (trademark) fabric as both the outer structural component and as a wick. This heat pipe has been successfully started up from a frozen condition against a negative 4 degree tilt (i.e., fluid return to evaporator was against gravity), with 75 W heat input, in ambient air. In a horizontal orientation, up to 100 W heat input was tolerated without experiencing dryout. DOE

N92-14175# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIGN, MICROSTRUCTURE, AND HIGH-TEMPERATURE BEHAVIOR OF SILICON NITRIDE SINTERED WITH RARE-EARTH OXIDES Ph.D. Thesis
M. K. Cinicukl (California Univ., Berkeley.) Aug. 1991 147 p
(Contract DE-AC03-76SF-00098)
(DE92-000815; LBL-31223) Avail: NTIS HC/MF A07

The processing-microstructure-property relations of silicon nitride ceramics sintered with rare-earth oxide additives have been investigated with the aim of improving their high-temperature behavior. The additions of the oxides of Y, Sm, Gd, Dy, Er, or Yb were compositionally controlled to tailor the intergranular phase. The resulting microstructure consisted of beta-Si3N4 grains and a crystalline secondary phase of RE2Si2O7, with a thin residual amorphous phase present at grain boundaries. The lanthanide oxides were found to be as effective as Y2O3 in densifying Si3N4, resulting in identical microstructures. The crystallization behavior of all six disilicates was similar, characterized by a limited nucleation and rapid growth mechanism resulting in large single crystals. Complete crystallization of the intergranular phase was obtained with the exception of a residual amorphous, observed at interfaces and believed to be rich in impurities, the cause of incomplete devitrification. The low resistance to oxidation of these materials was attributed to the minimization of amorphous phases via devitrification to disilicates, compatible with SiO2, the oxidation product of Si3N4. The strength retention of these materials at 1300 C was found to be between 80 percent and 91 percent of room-temperature strength, due to crystallization of the secondary phase and a residual but refractory amorphous grain-boundary phase. The creep behavior was found to be strongly dependent on residual amorphous phase viscosity as well as on the oxidation behavior, as evidenced by the nonsteady-state creep rates of all materials. DOE

N92-14176# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
SOLVENT SUBSTITUTION WITH NON-CHLORINATED BIODEGRADABLE SOLVENTS
C. A. Carpenter (Air Force Engineering and Services Center, Tyndall AFB, FL.) 1990 13 p Presented at the SUR/FIN '90: 77th American Electroplaters and Surface Finishers Society (AESF) Annual Technical Conference, Boston, MA, 9-12 Jul. 1990
(Contract DE-AC07-76ID-01570)
(DE91-018708; EGG-M-90299; CONF-9007145-4) Avail: NTIS HC/MF A03

Solvents and cleaners are used at the Air Force Air Logistics Centers in aircraft maintenance for removing wax, grease, oil, carbon and paint before repairing or electroplating the parts. Many, such as 1,1,1-trichloroethane, cannot be treated in industrial waste treatment plants (IWTPs) that remove organic chemicals by biological processing. These solvents will soon be strictly controlled by the EPA, and their use will become more expensive and less desirable. Chemical substitution with nontoxic or biodegradable solvents is the solution to the present problems with solvent cleaning. The substitution chemicals ultimately selected will be effective for removing greases, oils, carbon and many other soils and may be treated in IWTP. However, some of the solvents may require water rinsing of the parts after treatment to ensure a clean surface. In other cases, enhancement such as ultrasonics, spray washing or agitation may be required. DOE

N92-14177# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
IRRADIATION OF BI-BASED SUPERCONDUCTING CERAMICS WITH 650 MeV PROTONS
V. M. Drobin, E. I. Dyachkov (Joint Inst. for Nuclear Research, Dubna, USSR), and S. L. Zajtsev 1989 10 p
(DE91-628387; JINR-R-14-89-111) Avail: NTIS HC/MF A02

The critical temperature T(sub c), critical density I(sub c)(T) and R(T) of high temperature superconducting Bi-Sr-Cu-O ceramics before and after irradiation with 650 MeV protons in air at 300 K were measured. The fluence F varies from 10(exp 15) up to 4 x 10(exp 17)/sq cm. The measured I(sub c)(T) were fitted with I(sub c)(T) = A(T(sub c)-T)(exp a) and 'a' greater than 2 was found to be independent of or slightly dependent upon fluence while for Y-based high temperature superconductors (HTSC) 'a' less than 2 was found. The use of the above fit allows one to introduce T(sub c) more accurately. For the first time it has been found that the ratio F(sub Y)/F(sub Bi) at T(sub c)/T(sub co) = constant varies widely from 1 up to 50 and depends on the 'quality' of the sample. The quality can be expressed by T(sub co)/T(sub c) before irradiation, the width of the transition ((Delta)T(sub c)), stoichiometry, resistivity (rho(sub 0)(239 K)), and so on. One of the samples with T(sub co) = 108 K, rho(sub 0)(239 K) = 1.2 mOhm cm and T(sub co) = 1.2 K after irradiation with F = 1.75 x 10(exp 17)/sq. cm demonstrated F(sub Y)/F(sub Bi) less than 1 and thus a higher radioresistancy than Y-based HTSC. This shows the possibility of preparing Bi-based HTSC with a good radioresistancy which is no worse than for Y-based ceramics. DOE

N92-14178# Sandia National Labs., Albuquerque, NM.
PREOXIDATION CLEANING OPTIMIZATION FOR CRYSTALLINE SILICON
1991 13 p Presented at the 22nd IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 7-11 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000981; SAND-91-0434C; CONF-911055-3) Avail: NTIS HC/MF A03

A series of controlled experiments has been performed in Sandia's Photovoltaic Device Fabrication Laboratory to evaluate the effect of various chemical surface treatments on the recombination lifetime of crystalline silicon wafers subjected to a high temperature dry oxidation. From this series of experiments we have deduced a relatively simple yet effective cleaning sequence. We have also evaluated the effect of different chemical damage-removal etches for improving the recombination lifetime and surface smoothness of mechanically lapped wafers. This paper presents the methodology used, the experimental results obtained, and our experience with using this process on a continuing basis over a period of many months. DOE

N92-14179*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE CHEMISTRY OF SAUDI ARABIAN SAND: A DEPOSITION PROBLEM ON HELICOPTER TURBINE AIRFOILS
James L. Smialek 1991 11 p Presented at the Gordon Conference on Corrosion, New London, NH, 14 Jul. 1991
(NASA-TM-105234; E-6559; NAS 1.15:105234) Avail: NTIS HC/MF A03 CSCL 11C

Recent operations in the Persian Gulf have exposed military helicopter turbines to excessive amounts of ingested sand. Fine particles, less than 10 microns, are able to bypass the particle separators and enter the cooling and combustion systems. The initial sand chemistry varies by location, but is made up of a calcium aluminum silicate glass, SiO2 low quartz (Ca,Mg) CO3 dolomite, CaCO3 calcite, and occasionally CaCl rocksalt. The sand reacts in the hot combustion gases and deposits onto the turbine vanes as CaSO4, glass, and various crystalline silicates. Deposits up to 0.25 in. thick have been collected. Although cooling hole

plugging is a considerable problem, excessive corrosion is not commonly observed due to the high melting point of GaSO4.
Author

N92-14195# Technical Research Centre of Finland, Espoo. Metals Lab.
MATERIALS BEHAVIOUR IN THE DEEP SEA ENVIRONMENTS
Pekka Pohjanne and Amar Mahiout *In its* Underwater Technology Symposium Apr. 1991 p 69-83 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

N92-14461# Argonne National Lab., IL.
APPLICATIONS OF ENERGETIC PARTICLES IN IMPROVING COATING ADHESION PROPERTIES
George R. Fenske *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 64-69 (For primary document see N92-14445 05-44)
(Contract W-31-109-eng-38)
Avail: NTIS HC/MF A08

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-14180# Ballistic Research Labs., Aberdeen Proving Ground, MD.
APPLICATIONS OF FOURIER TRANSFORM INFRARED PHOTOACOUSTIC SPECTROSCOPY TO SOLID PROPELLANT CHARACTERIZATION Final Report, Jul. 1988 - Oct. 1990
Rose A. Pesce-Rodriguez and Robert A. Fifer Aug. 1991 22 p
(AD-A240857; BRL-TR-3260) Avail: NTIS HC/MF A03 CSCL 20/5

Fourier transform infrared photoacoustic spectroscopy (FT-IR-PAS) has been used to examine surfaces of composite solid propellants. Depletion of crystalline energetic material from extruded surfaces and of plasticizer from aged surfaces has been documented. In addition, a method has been developed to determine the mass per unit area of graphite on coated propellant surfaces. GRA

N92-14181# Cambridge Univ. (England).
DEFORMATION, FRACTURE AND EXPLOSIVE PROPERTIES OF REACTIVE MATERIALS Annual Report, May 1990 - May 1991
J. E. Field, N. K. Bourne, J. M. Huntley, S. M. Walley, and S. J. Palmer 30 Jun. 1991 52 p
(Contract DAJA45-90-C-0023)
(AD-A241123; R/D-4380A-R-AN) Avail: NTIS HC/MF A04 CSCL 19/1

A range of techniques has been developed for studies of the behavior of explosives when impacted and for recording their strength, failure and ignition properties. They include a drop-weight facility with transparent anvils, an instrumented drop-weight machine, a miniaturized Hopkinson bar system for high rate of strain property measurement, laser speckle for studies of deformation and fracture of PBX's, an automated system for analyzing speckle and moire records, and a heat sensitive film technique for recording the position and temperatures of hot spots. The report describes impact tests using transparent anvil drop-weight apparatus. It discusses the latest developments and recent applications with laser speckle and moire research. We now have the ability to combine these high spatial resolution techniques with high speed photographic recording. Impact on 2-D composite disc samples shows the importance of liner materials in reducing impact stresses. The application of laser speckle photography to measure the in-plane displacement fields resulting from the compression loading of cylindrical grains of inert solid propellants for guns is discussed. Microstructural studies on the failure surface of PBX's are presented. Results on a photographic study of shock-induced cavity collapse of both inert gels and reactive materials are presented. GRA

N92-14182 Department of the Navy, Washington, DC.
INHIBITOR AND BARRIER FOR USE WITH HIGH ENERGY ROCKET PROPELLANTS Patent
Russell Reed, Jr., inventor (to Navy) and May L. Chan, inventor (to Navy) 27 Aug. 1991 6 p Filed 24 Jan. 1983
(AD-D015023; US-Patent-5,042,385; US-Patent-Appl-SN-460682; US-Patent-Class-102-290) Avail: US Patent and Trademark Office CSCL 19/1

Described here is a flame inhibitor coating for application to those surfaces of a solid propellant grain in a rocket motor where burning is not desired, such as the aft end of a perforated propellant grain which includes a barrier layer of a mixture of amine silane, a trialkoxypropylsilylamino prepolymer, and diglycidylether of polypropylene glycol, an epoxy applied to the grain surface and allowed to cure to a polysiloxane layer, and a flame inhibitor layer applied over the barrier layer consisting of a mixture of hydroxyl terminated polybutadiene and dimeryl diisocyanate with flake aluminum which is applied over the barrier layer and allowed to cure. The barrier layer prevents migration of nitrate esters from the solid propellant grain to the flame inhibitor layer, thus preventing peeling and reduction of flame inhibiting properties. The polysiloxane barrier layer is also useful in itself as a flame inhibitor, and can also be employed between the insulator/liner of the rocket motor and the solid propellant grain. GRA

N92-14183 Department of the Navy, Washington, DC.
INSENSITIVE HIGH DENSITY EXPLOSIVE Patent
William P. Norris, inventor (to Navy) 13 Aug. 1991 2 p Filed 13 Apr. 1981
(AD-D015026; US-Patent-5,039,812; US-Patent-Appl-SN-259203)
Avail: US Patent and Trademark Office CSCL 19/1

The compound, 5.7-diamino-4,6-dinitro-benzofuroxan is formed by (1) forming a reaction mixture containing 4,6-dinitro benzofuroxan, potassium bicarbonate, hydroxylamine hydrochloride and water; (2) forming the potassium salt of the desired compound by adding potassium hydroxide to the reaction mixture; and (3) adding hydrogen chloride to replace the potassium ion of the salt with hydrogen. The compound is useful as an explosive. GRA

N92-14184# Department of the Navy, Washington, DC.
BINDERS FOR MELT CASTABLE PLASTIC BONDED EXPLOSIVES Patent Application
Edward E. Baroody, inventor (to Navy), Harold Argentar, inventor (to Navy), Carl Gotzmer, inventor (to Navy), and Joan S. Ross, inventor (to Navy) 10 May 1991 12 p
(AD-D015032; US-Patent-Appl-SN-700374) Avail: NTIS HC/MF A03 CSCL 19/1

The present invention relates in general to binders for melt castable plastic bonded explosives, and more particularly, to a binder system which desensitizes the explosive fill and which can be used in filling ordnance without the need for a baking step at elevated temperatures. In conventional melt castable explosives, a mixture containing an explosive such as trinitrotoluene (TNT), a fuel filler of aluminum powder, and optionally cyclotrimethylene trinitromine (RDX) is poured into the casing of the ordnance such as a bomb casing. This explosive charge solidifies and becomes very hard. This type of explosive fill is relatively sensitive to shock and does not pass insensitive munitions requirements such as resistance to thermal cook-off and sympathetic detonation. GRA

N92-14185# Oak Ridge National Lab., TN.
THE ULTIMATE ETHANOL: TECHNOECONOMIC EVALUATION OF ETHANOL MANUFACTURE, COMPARING YEAST VS (ITAL ZYMOMONAS) BACTERIUM FERMENTATIONS
R. M. Busche, C. D. Scott, B. H. Davison, and L. R. Lynd (Dartmouth Coll., Hanover, NH.) Aug. 1991 224 p
(Contract DE-AC05-84OR-21400)
(DE92-000402; ORNL/TM-11852) Avail: NTIS HC/MF A10

If ethanol could be produced at a low enough price to serve as the precursor to ethylene and butadiene, it and its derivatives could account for 159 billion lb, or 50 percent of the U.S. production of 316 billion lb of synthetic organic chemicals, presently valued at $113 billion. This use would consume 3.4 billion bu of corn, or approximately 40 percent of the corn crop. This study evaluates advanced process engineering and genetic engineering techniques that could generate savings and reduce production costs. The most rewarding development strategy appears to be to demonstrate at pilot scale the use of immobilized Zymomonas mobilis bacteria in a fluidized-bed bioreactor operating in a continuous mode over an extended period of time. Throughput should be adjusted to control product concentration at approximately 100 g/L (i.e., as close to the threshold of inhibition as possible). There appears to be no inherent design limitation to effect the engineering improvements required in the advanced process operation. The above scenario assumes that the presently available, product-inhibited organisms would be used. In a longer-term, more difficult research effort, it might be possible to reduce or eliminate product inhibition. As a result, price would be reduced further to $1.75 for the Zymomonas system or $1.85 for the yeast fermentation. It is recommended that the engineering proveout of the advanced process be continued at a pilot scale and that a laboratory program aimed at reducing product inhibition and/or increasing specific productivity be initiated. DOE

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N92-14186*# Utah State Univ., Logan.
DATA ANALYSIS AND INTERPRETATION RELATED TO SPACE SYSTEM/ENVIRONMENT INTERACTIONS AT LEO ALTITUDE Final Report
W. John Raitt and Robert W. Schunk Dec. 1991 46 p
(Grant NAG3-792)
(NASA-CR-189524; NAS 1.26:189524) Avail: NTIS HC/MF A03 CSCL 22A

Several studies made on the interaction of active systems with the LEO space environment experienced from orbital or suborbital platforms are covered. The issue of high voltage space interaction is covered by theoretical modeling studies of the interaction of charged solar cell arrays with the ionospheric plasma. The theoretical studies were complemented by experimental measurements made in a vacuum chamber. The other active system studied was the emission of effluent from a space platform. In one study the emission of plasma into the LEO environment was studied by using initially a 2-D model, and then extending this model to 3-D to correctly take account of plasma motion parallel to the geomagnetic field. The other effluent studies related to the releases of neutral gas from an orbiting platform. One model which was extended and used determined the density, velocity, and energy of both an effluent gas and the ambient upper atmospheric gases over a large volume around the platform. This model was adapted to study both ambient and contaminant distributions around smaller objects in the orbital frame of reference with scale sizes of 1 m. The other effluent studies related to the interaction of the released neutral gas with the ambient ionospheric plasma. An electrostatic model was used to help understand anomalously high plasma densities measured at times in the vicinity of the space shuttle orbiter. Author

N92-13984# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
MATERIALS PROCESSING IN SPACE
R. C. Tennyson, N. Salansky, W. D. Morison, and G. Fishbein et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 90-91 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-14187# Allied-Signal Aerospace Co., Kansas City, MO.
CNC WATER-JET MACHINING AND CUTTING CENTER
D. C. Bartlett Sep. 1991 25 p
(Contract DE-AC04-76DP-00613)
(DE92-000661; KCP-613-4397) Avail: NTIS HC/MF A03

Computer Numerical Control (CNC) water-jet machining was investigated to determine the potential applications and cost-effectiveness that would result by establishing this capability in the engineering shops of Allied-Signal Inc., Kansas City Division (KCD). Both conductive and nonconductive samples were machined at KCD on conventional machining equipment (a three-axis conversational programmed mill and a wire electrical discharge machine) and on two current-technology water-jet machines at outside vendors. These samples were then inspected, photographed, and evaluated. The current-technology water-jet machines were not as accurate as the conventional equipment. The resolution of the water-jet equipment was only +/- 0.005 inch, as compared to +/- 0.0002 inch for the conventional equipment. The principal use for CNC water-jet machining would be as follows: Contouring to near finished shape those items made from 300 and 400 series stainless steels, titanium, Inconel, aluminum, glass, or any material whose fabrication tolerance is less than the machine resolution of +/- 0.005 inch; and contouring to finished shape those items made from Kevlar, rubber, fiberglass, foam, aluminum, or any material whose fabrication specifications allow the use of a machine with +/- 0.005 inch tolerance. Additional applications are possible because there is minimal force generated on the material being cut and because the water-jet cuts without generating dust. DOE

N92-14188# Sandia National Labs., Albuquerque, NM.
SNL INITIATIVES IN ELECTRONIC FLUXLESS SOLDERING
F. M. Hosking, D. R. Frear, P. T. Vianco, and D. M. Keicher 1991 8 p Presented at the 1st International Congress on Environmentally Conscious Manufacturing, Santa Fe, NM, 18 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000818; SAND-91-1620C; CONF-9109259-9) Avail: NTIS HC/MF A02

Conventional soldering of electronic components generally requires the application of a chemical flux to promote solder wetting and flow. Chlorofluorocarbons (CFC) and halogenated solvents are normally used to remove the resulting flux residues. While such practice has been routinely accepted throughout the electronics industry, the environmental impact of hazardous solvents on ozone depletion will eventually limit or prevent their use. Solvent substitution or alternative technologies must be developed to meet these goals. Sandia National Laboratories (SNL), Albuquerque has a comprehensive environmentally conscious electronics manufacturing program underway that is funded by the DOE Office of Technology Development. Primary elements of the integrated task are the characterization and development of alternative fluxless soldering technologies that would eliminate circuit board cleaning associated with flux residue removal. Storage and handling of hazardous solvents and mixed solvent-flux waste would be consequently reduced during electronics soldering. This paper will report on the progress of the SNL fluxless soldering initiative. Emphasis is placed on the use of controlled atmospheres, laser heating, and ultrasonic soldering. DOE

N92-14189# California Univ., Berkeley. Lawrence Berkeley Lab.
PRE-TINNING AND FLUX CONSIDERATIONS ON THE RELIABILITY OF SOLDER SURFACE
A. J. Sunwoo, J. W. Morris, Jr., and G. K. Lucey (Harry Diamond Labs., Adelphi, MD.) Jul. 1991 16 p Presented at the Surface Mount International (SMI) Conference, San Jose, CA, 27-29 Aug. 1991

(Contract DE-AC03-76SF-00098)
(DE92-000905; LBL-31074; CONF-9108172-2) Avail: NTIS HC/MF A03

The kinetics of wetting were studied on several different prepared surfaces of copper (Cu) to simulate the microstructure observed in pre-tinned Cu-clad printed circuit boards. The results illustrate the effectiveness of pre-tinning in maintaining the solderability of Cu surfaces. Pre-tinning with Pb-rich solder (95Pb-5Sn) is particularly effective since solderability is preserved even after a relatively long aging treatment. On the other hand, pre-tinning with eutectic solder risks the loss of solderability during aging or baking due to surface exposure of an epsilon-phase intermetallic with poor wetting properties. The results also confirm the presence of carbon in pre-tinned specimens due to the use of flux. The effect of carbon on solderability is not yet known. DOE

N92-14190# Technical Research Centre of Finland, Espoo. Ship Lab.
UNDERWATER TECHNOLOGY SYMPOSIUM
Apr. 1991 148 p Symposium held in Espoo, Finland, 1 Nov. 1990
(VTT-120; ISBN-951-38-3950-8; ISSN-0357-9387; ETN-92-90678)
Copyright Avail: NTIS HC/MF A07

A research program on underwater technology aimed at underwater materials technology, flexible riser systems and underwater vehicles is reviewed. In the program high pressure research chambers for simulating deep sea conditions were constructed, a new wireless method for transmitting video images from a remotely operated vehicle to the support vessel was developed, and a simulation model for describing the motion dynamics of a subsea vehicle was programmed. Information about the objectives and results of the program is given. For individual titles, see N92-14191 through N92-14200.

N92-14191# Technical Research Centre of Finland, Espoo. Ship Lab.
MOTION DYNAMICS OF SUBMERSIBLES
Seppo Kalske *In its* Underwater Technology Symposium Apr. 1991 p 7-20 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

A literature survey of motion dynamics of subsea vehicles of a general shape was performed. Hydrodynamic tests were carried out with an existing tethered remotely operated vehicle and with its full scale model. The experiments give data of maneuvering capabilities, and of hydrodynamic characteristics of small subsea vehicles. A simulation method was developed on this basis to compute the vehicle trajectory in the time domain as a function of different control commands. The method can be applied to any subsea vehicle controlled by thruster units. ESA

N92-14192# Technical Research Centre of Finland, Espoo. Lab. of Electrical and Automation Engineering.
HYDROACOUSTIC TRANSMISSION OF VIDEO IMAGE FOR THE CONTROL OF A REMOTELY OPERATED UNDERSEA VEHICLE (ROV)
Kari Koskinen, Pekka Kohola, Esko Murtoviita, Juha Leppaenen, and Vaeinoe Typpi *In its* Underwater Technology Symposium Apr. 1991 p 21-36 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

A concept for enabling cableless transmission of live video images from a remotely operated undersea vehicle to a support vessel was developed and studied. This concept is based on the utilization of a hydroacoustic link for transmission and image preprocessing, compression and enhancement methods required by the bandwidth limitation of the link. The image processing methods were developed and tested in the laboratory by using videotape recorded picture material from real underwater operations. A feasibility assessment was made based on human judgement of the resulting live picture sequences. Realization of a realtime system was considered and discussed. ESA

N92-14193# Technical Research Centre of Finland, Espoo. Lab. of Electrical and Automation Engineering.
ENERGY SOURCE POSSIBILITIES IN UNDERWATER TECHNICS
Juho Farin *In its* Underwater Technology Symposium Apr. 1991 p 37-61 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Underwater energy source possibilities are treated. The power demand of underwater vehicles is restricted to approximately 0.5 MW. Besides well known primary and secondary batteries as well as conventional diesel engines and closed cycle diesels, fuel cells, radio nuclear isotopes and small nuclear reactors have already been installed or tested in conditions representative of underwater. ESA

N92-14194# Technical Research Centre of Finland, Tampere. Metals Lab.
PRESSURE CHAMBER FOR SIMULATION OF DEEP SEA CONDITIONS
Timo Saario *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 63-67 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Testing of materials and sensors to be used in deep sea conditions requires sophisticated equipment. The work done to develop a pressure chamber facility for simulation of deep sea conditions is described. The system developed enables electrochemical tests to be performed in order to determine materials resistance to corrosion, as well as mechanical tests to reveal materials resistance to stress corrosion or corrosion fatigue. ESA

N92-14195# Technical Research Centre of Finland, Espoo. Metals Lab.
MATERIALS BEHAVIOUR IN THE DEEP SEA ENVIRONMENTS **c27**
Pekka Pohjanne and Amar Mahiout *In its* Underwater Technology Symposium Apr. 1991 p 69-83 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Behavior of materials and applicability of protection methods in deep sea environments is studied. Literature reviews were done in order to find out the current state of knowledge. Corrosion tests were performed for different materials and coatings, both in laboratory and in simulated deep sea environments in the autoclave. Results indicate that the deep sea environment affects materials behavior, but the effect depends on the material and environment. ESA

N92-14196# Technical Research Centre of Finland, Espoo. Metals Lab.
DEVELOPMENT OF A CALIBRATION METHOD FOR DEEPSEA MAGNETIC PARTICLE TESTING **c38**
Thomas Aastroem *In its* Underwater Technology Symposium Apr. 1991 p 85-108 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

The most frequently used nondestructive testing methods for underwater applications are visual inspection and magnetic particle testing. Magnetic particle testing is used mainly due to the fact that its ability to indicate discontinuities under water is nearly as good as its ability to indicate discontinuities in the air. Magnetic particle testing was chosen as a target example in the sub project Manipulators: construction, control and sensor technology. The probability of detection in magnetic particle testing is a function of many parameters the most important of which is the choice of an appropriate magnetizing force and the calibration method for checking the level of magnetization. There are several weaknesses in the current calibrational methods for ROV- (remote operated vehicle) operated magnetic particle testing units. A remotely operated calibration method was developed to reduce these weaknesses and extensive comparative experimental tests were performed to evaluate the feasibility of the method. The calibration

method developed is intended to be used in conjunction with yoke magnetization and utilizes measurement of the flux in the poles by induction measurement. The method is called twin induction measurement. ESA

N92-14197# Technical Research Centre of Finland, Espoo. Lab. of Production Engineering.
TESTING A FORCE SENSOR FOR UNDERWATER MAGNETIC PARTICLE INSPECTION **c38**
Jaakko Vaelttilae *In its* Underwater Technology Symposium Apr. 1991 p 109-120 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Offshore oil and gas production installations require regular inspection of their underwater structures. Magnetic particle inspection (MPI) is one of the most reliable methods of detecting cracks in these parts. The use of underwater manipulators for remote controlled MPI was investigated. In the underwater MPI the magnetic field in the inspected material must be sufficiently strong. In order to determine the strength of the magnetic field a one axis force sensor was built into the manipulator measuring the force required in the lifting test. The AC powered yoke produced much stronger lifting power peaks than expected. The technical requirements for the lifting power measurement in remote controlled yoke lifting experiments can be defined based on these experiences. ESA

N92-14198# Technical Research Centre of Finland, Tampere. Machine Automation Lab.
TOOL EXCHANGER FOR UNDERWATER USE
Pasi Viitanen *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 121-128 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Underwater work is strongly related to oil production in offshore. Divers tasks include inspection, repair and maintenance. Risks are generated by pressure, cold water, changing visibility, noise and current. Remotely operated vehicles have been developed to replace free swimming or tethered diving. Manipulators have feedback controls with traditional on/off controls. Remote operations are restricted by lack of flexibility when tasks suddenly change. Flexibility has been gained using multipurpose tools and changeable tooling systems. An explanation of the workings of an underwater tool exchanger, designed to be small in size and weight, easy to machine and build, easy to maintain, reliable in use and cost effective, is given. ESA

N92-14199# Technical Research Centre of Finland, Oulu. Electronics Lab.
OPTICAL PROXIMITY SENSOR FOR UNDERWATER MANIPULATOR APPLICATIONS **c35**
Ilkka Moring *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 129-134 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

The design and realization of an optical, triangulation-based proximity sensor for underwater manipulator applications is described. The operating principle, sensor construction, and test environment are presented. Preliminary test results are shown. ESA

N92-14200# Technical Research Centre of Finland, Helsinki. Nuclear Engineering Lab.
DYNAMICS OF RISERS **c39**
Kari Ikonen and Jerzy Matusiak (Technical Research Centre of Finland, Espoo.) *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 135-148 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

Work done in the research project, Dynamics of flexible risers, is considered. The goal of the project was to develop a method capable of calculating dynamic responses of risers and thus enabling an evaluation of their strength and lifetime. The main problem considered is vortex induced vibrations of slender cylinders. A mathematical model based on experimental data was developed for dealing with this problem. The method uses the scheme of direct integration in time domain and iterates the interaction between the structure and fluid. ESA

N92-13947*# Kazan State Univ. (USSR). Dept. of Applied Mathematics.
OPTIMIZATION OF THE HEATING SURFACE SHAPE IN THE CONTACT MELTING PROBLEM
Sergei A. Fomin and Shangmo Cheng (Huazhong Univ. of Science and Technology, Wuhan, China) *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 253-262 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13B

N92-13966*# Moscow Inst. of Aviation Technology (USSR). Dept. of Space System Engineering and Design.
INVERSE PROBLEMS IN THE DESIGN, MODELING AND TESTING OF ENGINEERING SYSTEMS
Oleg M. Alifanov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 495-512 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13B

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-14201 Council for National Academic Awards (England).
TRANSHORIZON MICROWAVE PROPAGATION AND ITS RELATIONSHIP WITH METEOROLOGICAL CONDITIONS Ph.D. Thesis
Candida Spillard 1990 231 p
Avail: Univ. Microfilms Order No. BRDX92639

The measurement and modeling of X-Band transhorizon propagation is addressed. Propagation of microwaves beyond the horizon can occur by the mechanism of scattering from eddies of atmospheric turbulence or from hydrometers, partial reflection from stable atmospheric layers of feuillets, diffraction, and ducting. The dominant mechanism operating on a link at any given time is dependent upon the weather conditions. From a network of X-Band links across the English Channel (La Manche) examples of propagation due to turbulent scatter, hydrometer scatter, partial reflections and ducting were identified. Models were developed for propagation due to turbulent and hydrometeor scatter and to partial reflections. The method for predicting the signal levels received due to scattering mechanisms is based on the Radar Equation, with the Rayleigh differential scattering cross-section in the case of rain scatter, and a differential scattering cross-section calculated using a Kolmogorov spectrum of eddy sizes in a turbulent atmosphere. The model for propagation by partial reflections is based on the Friis transmission equation together with the Fresnel reflection coefficients of layers with known refractivity profiles. A method for identifying which mechanism is operating over a link at a given time from the meteorological synoptic chart for that time was developed. In this study, ducting was modeled as total reflection, since at X-Band frequencies ray-tracing modeling can be used with negligible loss of accuracy. Turbulent scatter is the dominant mechanism when the link is under the influence of depressions or fronts. The meteorological classification method was applied to 12 months of data, from Jun. 1988 to May 1989. It was found that although most of the synoptic charts are relatively easily classified, discrete categories are not always easily applied

to the continuous range of meteorological conditions. Some 5 percent of charts were difficult to classify. Some of these could on occasion have a disproportionately large effect on the overall cumulative distribution prediction. Dissert. Abstr.

N92-14202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE COMMUNICATIONS TECHNOLOGY CONFERENCE: ONBOARD PROCESSING AND SWITCHING
Washington Nov. 1991 288 p Conference held in Cleveland, OH, 12-14 Nov. 1991
(NASA-CP-3132; E-6548; NAS 1.55:3132) Avail: NTIS HC/MF A13 CSCL 17B

Papers and presentations from the conference are presented. The topics covered include the following: satellite network architecture, network control and protocols, fault tolerance and autonomy, multichanned demultiplexing and demodulation, information switching and routing, modulation and coding, and planned satellite communications systems. For individual titles, see N92-14203 through N92-14235.

N92-14203*# Communications Satellite Corp., Clarksburg, MD.
ON-BOARD PROCESSING ARCHITECTURES FOR SATELLITE B-ISDN SERVICES
Thomas Inukai, Dong-Jye Shyy, and Faris Faris *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 1-7 (For primary document see N92-14202 05-32)
(Contract NASw-4528)
Avail: NTIS HC/MF A13 CSCL 17B

Onboard baseband processing architectures for future satellite broadband integrated services digital networks (B-ISDN's) are addressed. To assess the feasibility of implementing satellite B-ISDN services, critical design issues, such as B-ISDN traffic characteristics, transmission link design, and a trade-off between onboard circuit and fast packet switching, are analyzed. Examples of the two types of switching mechanisms and potential onboard network control functions are presented. A sample network architecture is also included to illustrate a potential onboard processing system. Author

N92-14204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DESTINATION DIRECTED PACKET SWITCH ARCHITECTURE FOR A 30/20 GHz FDMA/TDM GEOSTATIONARY COMMUNICATION SATELLITE NETWORK
William D. Ivancic and Mary Jo Shalkhauser *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 9-24 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Emphasis is on a destination directed packet switching architecture for a 30/20 GHz frequency division multiplex access/time division multiplex (FDMA/TDM) geostationary satellite communication network. Critical subsystems and problem areas are identified and addressed. Efforts have concentrated heavily on the space segment; however, the ground segment was considered concurrently to ensure cost efficiency and realistic operational constraints. Author

N92-14205*# Stanford Telecommunications, Inc., Reston, VA.
A CODE PHASE DIVISION MULTIPLE ACCESS (CPDMA) TECHNIQUE FOR VSAT SATELLITE COMMUNICATIONS
R. Bruno, R. McOmber, and A. Weinberg *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 25-31 (For primary document see N92-14202 05-32)
(Contract NAS3-25091)
Avail: NTIS HC/MF A13 CSCL 17B

A reference concept and implementation relevant to the application of Code Phase Division Multiple Access (CPDMA) to a high capacity satellite communication system providing 16 Kbps single hop channels between Very Small Aperture Terminals (VSAT's) is described. The description includes a potential implementation of an onboard CPDMA bulk demodulator/converter utilizing programmable charge coupled device (CCD) technology projected to be available in the early 1990's. A high level description of the system architecture and operations, identification of key functional and performance requirements of the system elements, and analysis results of end-to-end system performance relative to key figures of merit such as spectral efficiency are also provided. Author

N92-14206*# Space Systems/Loral, Palo Alto, CA.
MOBILE TELEPHONY THROUGH LEO SATELLITES: TO OBP OR NOT
Paul A. Monte, Ming Louie, and R. Wiedeman (Loral Aerospace Corp., San Jose, CA.) *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 33-39 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

GLOBALSTAR is a satellite-based mobile communications system that is interoperable with the current and future Public Land Mobile Network (PLMN) and Public Switched Telephone Network (PSTN). The selection of the transponder type, bent-pipe, or onboard processing (OBP), for GLOBALSTAR is based on many criteria, each of which is essential to the commercial and technological feasibility of GLOBALSTAR. The trade study that was done to determine the pros and cons of a bent-pipe transponder or an onboard processing transponder is described. The design of GLOBALSTAR's telecommunications system is a multi-variable cost optimization between the cost and complexity of individual satellites, the number of satellites required to provide coverage to the service areas, the cost of launching the satellites into their selected orbits, the ground segment cost, user equipment cost, satellite voice channel capacity, and other issues. Emphasis is on the cost and complexity of the individual satellites, specifically the transponder type and the impact of the transponder type on satellite and ground segment cost, satellite power and weight, and satellite voice channel capacity. Author

N92-14207*# Communications Satellite Corp., Clarksburg, MD.
SATELLITE COMMUNICATIONS FOR THE NEXT GENERATION TELECOMMUNICATION SERVICES AND NETWORKS
D. M. Chitre *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 41-49 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Satellite communications can play an important role in provisioning the next-generation telecommunication services and networks, provided the protocols specifying these services and networks are satellite-compatible and the satellite subnetworks, consisting of earth stations interconnected by the processor and the switch on board the satellite, interwork effectively with the terrestrial networks. The specific parameters and procedures of frame relay and broadband integrated services digital network (B-ISDN) protocols which are impacted by a satellite delay. Congestion and resource management functions for frame relay and B-ISDN are discussed in detail, describing the division of these functions between earth stations and on board the satellite. Specific onboard and ground functions are identified as potential candidates for their implementation via neural network technology. Author

N92-14208*# Communications Satellite Corp., Clarksburg, MD.
SATELLITE B-ISDN TRAFFIC ANALYSIS
Dong-Jye Shyy and Thomas Inukai *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 51-59 (For primary document see N92-14202 05-32)
(Contract NASw-4528)
Avail: NTIS HC/MF A13 CSCL 17B

The impact of asynchronous transfer mode (ATM) traffic on

the advanced satellite broadband integrated services digital network (B-ISDN) with onboard processing is reported. Simulation models were built to analyze the cell transfer performance through the statistical multiplexer at the earth station and the fast packet switch at the satellite. The effectiveness of ground ATM cell preprocessing was established, as well as the performance of several schemes for improving the down-link beam utilization when the space segment employs a fast packet switch. Author

N92-14209*# Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.

A MULTIDISCIPLINARY APPROACH TO THE DEVELOPMENT OF LOW-COST HIGH-PERFORMANCE LIGHTWAVE NETWORKS

Jacek Maitan and Alex Harwit *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 61-67 (For primary document see N92-14202 05-32)

(Contract NAS2-13223)

Avail: NTIS HC/MF A13 CSCL 17B

Our research focuses on high-speed distributed systems. We anticipate that our results will allow the fabrication of low-cost networks employing multi-gigabit-per-second data links for space and military applications. The recent development of high-speed low-cost photonic components and new generations of microprocessors creates an opportunity to develop advanced large-scale distributed information systems. These systems currently involve hundreds of thousands of nodes and are made up of components and communications links that may fail during operation. In order to realize these systems, research is needed into technologies that foster adaptability and scaleability. Self-organizing mechanisms are needed to integrate a working fabric of large-scale distributed systems. The challenge is to fuse theory, technology, and development methodologies to construct a cost-effective, efficient, large-scale system. Author

N92-14210*# Rome Air Development Center, Griffiss AFB, NY.

ARCHITECTURE FOR SURVIVABLE SYSTEM PROCESSING (ASSP)

Richard J. Wood *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 69-74 (For primary document see N92-14202 05-32)

Avail: NTIS HC/MF A13 CSCL 17B

The Architecture for Survivable System Processing (ASSP) Program is a multi-phase effort to implement Department of Defense (DOD) and commercially developed high-tech hardware, software, and architectures for reliable space avionics and ground based systems. System configuration options provide processing capabilities to address Time Dependent Processing (TDP), Object Dependent Processing (ODP), and Mission Dependent Processing (MDP) requirements through Open System Architecture (OSA) alternatives that allow for the enhancement, incorporation, and capitalization of a broad range of development assets. High technology developments in hardware, software, and networking models, address technology challenges of long processor life times, fault tolerance, reliability, throughput, memories, radiation hardening, size, weight, power (SWAP) and security. Hardware and software design, development, and implementation focus on the interconnectivity/interoperability of an open system architecture and is being developed to apply new technology into practical OSA components. To insure for widely acceptable architecture capable of interfacing with various commercial and military components, this program provides for regular interactions with standardization working groups (e.g.) the International Standards Organization (ISO), American National Standards Institute (ANSI), Society of Automotive Engineers (SAE), and Institute of Electrical and Electronic Engineers (IEEE). Selection of a viable open architecture is based on the widely accepted standards that implement the ISO/OSI Reference Model. Author

N92-14211*# University of South Australia, Pooraka.

A BANDWIDTH EFFICIENT CODING SCHEME FOR THE HUBBLE SPACE TELESCOPE

Steven S. Pietrobon and Daniel J. Costello, Jr. (Notre Dame Univ., IN.) *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 75-81 Sponsored in part by OTC Ltd. (For primary document see N92-14202 05-32)

(Grant NAG5-557)

Avail: NTIS HC/MF A13 CSCL 17B

As a demonstration of the performance capabilities of trellis codes using multidimensional signal sets, a Viterbi decoder was designed. The choice of code was based on two factors. The first factor was its application as a possible replacement for the coding scheme currently used on the Hubble Space Telescope (HST). The HST at present uses the rate 1/3 nu = 6 (with 2 (exp nu) = 64 states) convolutional code with Binary Phase Shift Keying (BPSK) modulation. With the modulator restricted to a 3 Msym/s, this implies a data rate of only 1 Mbit/s, since the bandwidth efficiency K = 1/3 bit/sym. This is a very bandwidth inefficient scheme, although the system has the advantage of simplicity and large coding gain. The basic requirement from NASA was for a scheme that has as large a K as possible. Since a satellite channel was being used, 8PSK modulation was selected. This allows a K of between 2 and 3 bit/sym. The next influencing factor was INTELSAT's intention of transmitting the SONET 155.52 Mbit/s standard data rate over the 72 MHz transponders on its satellites. This requires a bandwidth efficiency of around 2.5 bit/sym. A Reed-Solomon block code is used as an outer code to give very low bit error rates (BER). A 16 state rate 5/6, 2.5 bit/sym, 4D-8PSK trellis code was selected. This code has reasonable complexity and has a coding gain of 4.8 dB compared to uncoded 8PSK (2). This trellis code also has the advantage that it is 45 deg rotationally invariant. This means that the decoder needs only to synchronize to one of the two naturally mapped 8PSK signals in the signal set. Author

N92-14212*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN OVERVIEW OF SPACE COMMUNICATION ARTIFICIAL INTELLIGENCE FOR LINK EVALUATION TERMINAL (SCAILET) PROJECT

Anoosh K. Shahidi, Richard F. Schlegelmilch (Akron Univ., OH.), Edward J. Petrik, and Jerry L. Walters *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 83-86 (For primary document see N92-14202 05-32)

Avail: NTIS HC/MF A13 CSCL 17B

A software application to assist end-users of the link evaluation terminal (LET) for satellite communications is being developed. This software application incorporates artificial intelligence (AI) techniques and will be deployed as an interface to LET. The high burst rate (HBR) LET provides 30 GHz transmitting/20 GHz receiving (220/110 Mbps) capability for wideband communications technology experiments with the Advanced Communications Technology Satellite (ACTS). The HBR LET can monitor and evaluate the integrity of the HBR communications uplink and downlink to the ACTS satellite. The uplink HBR transmission is performed by bursting the bit-pattern as a modulated signal to the satellite. The HBR LET can determine the bit error rate (BER) under various atmospheric conditions by comparing the transmitted bit pattern with the received bit pattern. An algorithm for power augmentation will be applied to enhance the system's BER performance at reduced signal strength caused by adverse conditions. Author

N92-14213*# Toledo Univ., OH. Dept. of Electrical Engineering.

A RECONFIGURABLE MULTICARRIER DEMODULATOR ARCHITECTURE

S. C. Kwatra and M. M. Jamali *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 87-93 (For primary

document see N92-14202 05-32)
(Grant NAG3-799)
Avail: NTIS HC/MF A13 CSCL 17B

An architecture based on parallel and pipline design approaches has been developed for the Frequency Division Multiple Access/Time Domain Multiplexed (FDMA/TDM) conversion system. The architecture has two main modules namely the transmultiplexer and the demodulator. The transmultiplexer has two pipelined modules. These are the shared multiplexed polyphase filter and the Fast Fourier Transform (FFT). The demodulator consists of carrier, clock, and data recovery modules which are interactive. Progress on the design of the MultiCarrier Demodulator (MCD) using commercially available chips and Application Specific Integrated Circuits (ASIC) and simulation studies using Viewlogic software will be presented at the conference. Author

N92-14214*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
VIDEO DATA COMPRESSION USING ARTIFICIAL NEURAL NETWORK DIFFERENTIAL VECTOR QUANTIZATION
Ashok K. Krishnamurthy, Steven B. Bibyk, and Stanley C. Ahalt *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 95-101 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

An artificial neural network vector quantizer is developed for use in data compression applications such as Digital Video. Differential Vector Quantization is used to preserve edge features, and a new adaptive algorithm, known as Frequency-Sensitive Competitive Learning, is used to develop the vector quantizer codebook. To develop real time performance, a custom Very Large Scale Integration Application Specific Integrated Circuit (VLSI ASIC) is being developed to realize the associative memory functions needed in the vector quantization algorithm. By using vector quantization, the need for Huffman coding can be eliminated, resulting in superior performance against channel bit errors than methods that use variable length codes. Author

N92-14215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GTEX: AN EXPERT SYSTEM FOR DIAGNOSING FAULTS IN SATELLITE GROUND STATIONS
Richard F. Schlegelmilch, John Durkin (Akron Univ., OH.), and Edward J. Petrik *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 103-112 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

A proof of concept expert system called Ground Terminal Expert (GTEX) was developed at The University of Akron in collaboration with NASA Lewis Research Center. The objective of GTEX is to aid in diagnosing data faults occurring with a digital ground terminal. This strategy can also be applied to the Very Small Aperture Terminal (VSAT) technology. An expert system which detects and diagnoses faults would enhance the performance of the VSAT by improving reliability and reducing maintenance time. GTEX is capable of detecting faults, isolating the cause and recommending appropriate actions. Isolation of faults is completed to board-level modules. A graphical user interface provides control and a medium where data can be requested and cryptic information logically displayed. Interaction with GTEX consists of user responses and input from data files. The use of data files provides a method of simulating dynamic interaction between the digital ground terminal and the expert system. GTEX as described is capable of both improving reliability and reducing the time required for necessary maintenance. Author

N92-14216*# International Telecommunications Satellite Organization, Washington, DC.
LABORATORY MEASUREMENTS OF ON-BOARD SUBSYSTEMS
P. P. Nuspl, G. Dong, and H. C. Seran *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 113-133 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Good progress was achieved on the test bed for on-board subsystems for future satellites. The test bed is for subsystems developed previously. Four test setups were configured in the INTELSAT technical labs: (1) TDMA on-board modem; (2) multicarrier demultiplexer demodulator; (3) IBS/IDR baseband processor; and (4) baseband switch matrix. The first three series of tests are completed and the tests on the BSM are in progress. Descriptions of test setups and major test results are included; the format of the presentation is outlined. Author

N92-14217*# TRW Space Technology Labs., Redondo Beach, CA. Space and Technology Group.
GETTING EXPERT SYSTEMS OFF THE GROUND: LESSONS LEARNED FROM INTEGRATING MODEL-BASED DIAGNOSTICS WITH PROTOTYPE FLIGHT HARDWARE
Amy Stephan and Carol A. Erikson *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 135-141 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

As an initial attempt to introduce expert system technology into an onboard environment, a model based diagnostic system using the TRW MARPLE software tool was integrated with prototype flight hardware and its corresponding control software. Because this experiment was designed primarily to test the effectiveness of the model based reasoning technique used, the expert system ran on a separate hardware platform, and interactions between the control software and the model based diagnostics were limited. While this project met its objective of showing that model based reasoning can effectively isolate failures in flight hardware, it also identified the need for an integrated development path for expert system and control software for onboard applications. In developing expert systems that are ready for flight, artificial intelligence techniques must be evaluated to determine whether they offer a real advantage onboard, identify which diagnostic functions should be performed by the expert systems and which are better left to the procedural software, and work closely with both the hardware and the software developers from the beginning of a project to produce a well designed and thoroughly integrated application. Author

N92-14218*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIDEX: AN EXPERT SYSTEM FOR SATELLITE DIAGNOSTICS
John Durkin, Donald Tallo (Akron Univ., OH.), and Edward J. Petrik *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 143-152 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

A Fault Isolation and Diagnostic Expert system (FIDEX) was developed for communication satellite diagnostics. It was designed specifically for the 30/20 GHz satellite transponder. The expert system was designed with a generic structure and features that make it applicable to other types of space systems. FIDEX is a frame based system that enjoys many of the inherent frame base features, such as hierarchy that describes the transponder's components, with other hierarchies that provide structural and fault information about the transponder. This architecture provides a flexible diagnostic structure and enhances maintenance of the system. FIDEX also includes an inexact reasoning technique and a primitive learning ability. Inexact reasoning was an important feature for this system due to the sparse number of sensors available to provide information on the transponder's performance. FIDEX can determine the most likely faulted component under the constraint of limited information. FIDEX learns about the most likely faults in the transponder by keeping a record of past established faults. FIDEX also has the ability to detect anomalies in the sensors that provide information on the transponders performance. Author

N92-14219*# Honeywell, Inc., Glendale, AZ. Satellite Systems Operation.
FAULT-TOLERANCE TECHNIQUES FOR HIGH-SPEED FIBER-OPTIC NETWORKS
John DeRuiter *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 153-159 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Four fiber optic network topologies (linear bus, ring, central star, and distributed star) are discussed relative to their application to high data throughput, fault tolerant networks. The topologies are also examined in terms of redundancy and the need to provide for single point, failure free (or better) system operation. Linear bus topology, although traditionally the method of choice for wire systems, presents implementation problems when larger fiber optic systems are considered. Ring topology works well for high speed systems when coupled with a token passing protocol, but it requires a significant increase in protocol complexity to manage system reconfiguration due to ring and node failures. Star topologies offer a natural fault tolerance, without added protocol complexity, while still providing high data throughput capability. Author

N92-14220*# California Univ., Davis. Dept. of Electrical Engineering and Computer Science.
FAULT-TOLERANT MULTICHANNEL DEMULTIPLEXER SUBSYSTEMS
Robert Redinbo *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing anu Switching Nov. 1991 p 161-167 (For primary document see N92-14202 05-32)
(Grants NAG3-1166; NSF MIP-90-02664)
Avail: NTIS HC/MF A13 CSCL 17B

Fault tolerance in future processing and switching communication satellites is addressed by showing new methods for detecting hardware failures in the first major subsystem, the multichannel demultiplexer. An efficient method for demultiplexing frequency slotted channels uses multirate filter banks which contain fast Fourier transform processing. All numerical processing is performed at a lower rate commensurate with the small bandwidth of each bandbase channel. The integrity of the demultiplexing operations is protected by using real number convolutional codes to compute comparable parity values which detect errors at the data sample level. High rate, systematic convolutional codes produce parity values at a much reduced rate, and protection is achieved by generating parity values in two ways and comparing them. Parity values corresponding to each output channel are generated in parallel by a subsystem, operating even slower and in parallel with the demultiplexer that is virtually identical to the original structure. These parity calculations may be time shared with the same processing resources because they are so similar. Author

N92-14221*# Communications Satellite Corp., Clarksburg, MD.
ON-BOARD DEMUX/DEMOD
S. Sayegh, M. Kappes, J. Thomas, J. Snyder, M. Eng, John J. Poklemba, M. Steber, and G. House *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 169-177 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

To make satellite channels cost competitive with optical cables, the use of small, inexpensive earth stations with reduced antenna size and high powered amplifier (HPA) power will be needed. This will necessitate the use of high e.i.r.p. and gain-to-noise temperature ratio (G/T) multibeam satellites. For a multibeam satellite, onboard switching is required in order to maintain the needed connectivity between beams. This switching function can be realized by either an receive frequency (RF) or a baseband unit. The baseband switching approach has the additional advantage of decoupling the up-link and down-link, thus enabling rate and format conversion as well as improving the link performance. A baseband switching satellite requires the demultiplexing and demodulation of the up-link carriers before they can be switched to their assigned down-link beams. Principles of operation, design and implementation issues of such an onboard demultiplexer/demodulator (bulk demodulator) that was recently built at COMSAT Labs. are discussed. Author

N92-14222*# Westinghouse Electric Corp., Baltimore, MD.
OPTIMIZATION OF AN OPTICALLY IMPLEMENTED ON-BOARD FDMA DEMULTIPLEXER
J. Fargnoli and L. Riddle *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 179-189 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Performance of a 30 GHz frequency division multiple access (FDMA) uplink to a processing satellite is modelled for the case where the onboard demultiplexer is implemented optically. Included in the performance model are the effects of adjacent channel interference, intersymbol interference, and spurious signals associated with the optical implementation. Demultiplexer parameters are optimized to provide the minimum bit error probability at a given bandwidth efficiency when filtered QPSK modulation is employed. Author

N92-14223*# TRW Space Technology Labs., Redondo Beach, CA. Electronic Systems Group.
DESIGN, MODELING, AND ANALYSIS OF MULTI-CHANNEL DEMULTIPLEXER/DEMODULATOR
David D. Lee and K. T. Woo *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 191-197 (For primary document see N92-14202 05-32)
(Contract NAS3-25866)
Avail: NTIS HC/MF A13 CSCL 17B

Traditionally, satellites have performed the function of a simple repeater. Newer data distribution satellite architectures, however, require demodulation of many frequency division multiplexed uplink channels by a single demultiplexer/demodulator unit, baseband processing and routing of individual voice/data circuits, and remodulation into time division multiplexed (TDM) downlink carriers. The TRW MCDD (Multichannel Demultiplexer/Multirate Demodulator) operates on a 37.4 MHz composite input signal. Individual channel data rates are either 64 Kbps or 2.048 Mbps. The wideband demultiplexer divides the input signal into 1.44 MHz segments containing either a single 2.048 Mbps channel or thirty two 64 Kbps channels. In the latter case, the narrowband demultiplexer further divides the single 1.44 MHz wideband channel into thirty two 45 KHz narrowband channels. With this approach the time domain Fast Fourier Transformation (FFT) channelizer processing capacity is matched well to the bandwidth and number of channels to be demultiplexed. By using a multirate demodulator fewer demodulators are required while achieving greater flexibility. Each demodulator can process a wideband channel or thirty two narrowband channels. Either all wideband channels, a mixture of wideband and narrowband channels, or all narrowband channels can be demodulated. The multirate demodulator approach also has lower nonrecurring costs since only one design and development effort is needed. TRW has developed a proof of concept (POC) model which fully demonstrates the signal processing fuctions of MCDD. It is capable of processing either three 2.048 Mbps channels or two 2.048 Mbps channels and thirty two 64 Kbps channels. An overview of important MCDD system engineering issues is presented as well as discussion on some of the Block Oriented System Simulation analyses performed for design verification and selection of operational parameters of the POC model. Systems engineering analysis of the POC model confirmed that the MCDD concepts are not only achievable but also balance the joint goals of minimizing on-board complexity and cost of ground equipment, while retaining the flexibility needed to meet a wide range of system requirements. Author

N92-14224*# Amerasia Technology, Inc., Westlake Village, CA.
APPLICATION OF CONVOLVE-MULTIPLY-CONVOLVE SAW PROCESSOR FOR SATELLITE COMMUNICATIONS

Y. S. Lie and M. Ching *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 199-205 (For primary document see N92-14202 05-32)
(Contract NAS3-25862)
Avail: NTIS HC/MF A13 CSCL 17B

There is a need for a satellite communications receiver than can perform simultaneous multi-channel processing of single channel per carrier (SCPC) signals originating from various small (mobile or fixed) earth stations. The number of ground users can be as many as 1000. Conventional techniques of simultaneously processing these signals is by employing as many RF-bandpass filters as the number of channels. Consequently, such an approach would result in a bulky receiver, which becomes impractical for satellite applications. A unique approach utilizing a realtime surface acoustic wave (SAW) chirp transform processor is presented. The application of a Convolve-Multiply-Convolve (CMC) chirp transform processor is described. The CMC processor transforms each input channel into a unique timeslot, while preserving its modulation content (in this case QPSK). Subsequently, each channel is individually demodulated without the need of input channel filters. Circuit complexity is significantly reduced, because the output frequency of the CMC processor is common for all input channel frequencies. The results of theoretical analysis and experimental results are in good agreement. Author

N92-14225*# Communications Satellite Corp., Clarksburg, MD.
COMSAT LABORATORIES' ON-BOARD BASEBAND SWITCH DEVELOPMENT
B. A. Pontano, W. A. Redman, Thomas Inukai, R. Razdan, and D. K. Paul *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 207-213 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Work performed at COMSAT Laboratories to develop a prototype on-board baseband switch is summarized. The switch design is modular to accommodate different service types, and the architecture features a high-speed optical ring operating at 1 Gbit/s to route input (up-link) channels to output (down-link) channels. The switch is inherently a packet switch, but can process either circuit-switched or packet-switched traffic. If the traffic arrives at the satellite in a circuit-switched mode, the input processor packetizes it and passes it on to the switch. The main advantage of the packet approach lies in its simplified control structure. Details of the switch architecture and design, and the status of its implementation, are presented. Author

N92-14226*# British Aerospace Public Ltd. Co., Stevenage (England). Space Systems Div.
AN ADVANCED OBP-BASED PAYLOAD OPERATING IN AN ASYNCHRONOUS NETWORK FOR FUTURE DATA RELAY SATELLITES UTILISING CCSDS-STANDARD DATA STRUCTURES
M. Grant and A. Vernucci (Telespazio, S.p.A., Rome, Italy) *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 215-221 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

A possible Data Relay Satellite System (DRSS) topology and network architecture is introduced. An asynchronous network concept, whereby each link (Inter-orbit, Inter-satellite, Feeder) is allowed to operate on its own clock, without causing loss of information, in conjunction with packet data structures, such as those specified by the CCSDS for advanced orbiting systems is discussed. A matching OBP payload architecture is described, highlighting the advantages provided by the OBP-based concept and then giving some indications on the OBP mass/power requirements. Author

N92-14227*# International Telecommunications Satellite Organization, Washington, DC.
ON-BOARD PROCESSING FOR TELECOMMUNICATIONS SATELLITES
P. P. Nuspl and G. Dong *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 223-238 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

In this decade, communications satellite systems will probably face dramatic challenges from alternative transmission means. To balance and overcome such competition, and to prepare for new requirements, INTELSAT has developed several on-board processing techniques, including Satellite-Switched TDMA (SS-TDMA), Satellite-Switched FDMA (SS-FDMA), several Modulators/Demodulators (Modem), a Multicarrier Multiplexer and Demodulator MCDD), an International Business Service (IBS)/Intermediate Data Rate (IDR) BaseBand Processor (BBP), etc. Some proof-of-concept hardware and software were developed, and tested recently in the INTELSAT Technical Laboratories. These techniques and some test results are discussed. Author

N92-14228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON-BOARD CONGESTION CONTROL FOR SATELLITE PACKET SWITCHING NETWORKS
Pong P. Chu (Cleveland State Univ., OH.) *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 239-245 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

It is desirable to incorporate packet switching capability on-board for future communication satellites. Because of the statistical nature of packet communication, incoming traffic fluctuates and may cause congestion. Thus, it is necessary to incorporate a congestion control mechanism as part of the on-board processing to smooth and regulate the bursty traffic. Although there are extensive studies on congestion control for both baseband and broadband terrestrial networks, these schemes are not feasible for space based switching networks because of the unique characteristics of satellite link. Here, we propose a new congestion control method for on-board satellite packet switching. This scheme takes into consideration the long propagation delay in satellite link and takes advantage of the the satellite's broadcasting capability. It divides the control between the ground terminals and satellite, but distributes the primary responsibility to ground terminals and only requires minimal hardware resource on-board satellite. Author

N92-14229*# Communications Satellite Corp., Clarksburg, MD.
A B-ISDN-COMPATIBLE MODEM/CODEC
F. Hemmati and S. Miller *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 247-253 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

Coded modulation techniques for development of a broadband integrated services digital network (B-ISDN)-compatible modem/codec are investigated. The selected baseband processor system must support transmission of 155.52 Mbit/s of data over an INTELSAT 72-MHz transponder. Performance objectives and fundamental system parameters, including channel symbol rate, code rate, and the modulation scheme are determined. From several candidate codes, a concatenated coding system consisting of a coded octal phase shift keying modulation as the inner code and a high rate Reed-Solomon as the outer code is selected and its bit error rate performance is analyzed by computer simulation. The hardware implementation of the decoder for the selected code is also described. Author

N92-14230*# Harris Corp., Melbourne, FL. Government Systems Sector.
FLEXIBLE HIGH SPEED CODEC (FHSC)

G. P. Segallis and J. V. Wernlund *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 255-261 (For primary document see N92-14202 05-32)
(Contract NAS3-25087)
Avail: NTIS HC/MF A13 CSCL 17B

The ongoing NASA/Harris Flexible High Speed Codec (FHSC) program is described. The program objectives are to design and build an encoder decoder that allows operation in either burst or continuous modes at data rates of up to 300 megabits per second. The decoder handles both hard and soft decision decoding and can switch between modes on a burst by burst basis. Bandspreading is low since the code rate is greater than or equal to 7/8. The encoder and a hard decision decoder fit on a single application specific integrated circuit (ASIC) chip. A soft decision applique is implemented using 300 K emitter coupled logic (ECL) which can be easily translated to an ECL gate array. Author

N92-14231*# Communications Satellite Corp., Clarksburg, MD.
PROGRAMMABLE DIGITAL MODEM
John J. Poklemba *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 263-271 (For primary document see N92-14202 05-32)
(Contract NAS3-25715)
Avail: NTIS HC/MF A13 CSCL 17B

The design of the Programmable Digital Modem (PDM) is outlined. The PDM will be capable of operating with numerous modulation techniques including: 2-, 4-, 8- and 16-ary phase shift keying (PSK), minimum shift keying (MSK), and 16-ary quadrature amplitude modulation (QAM), with spectral occupancy from 1.2x to 2x the data symbol rate. It will also be programmable for transmission rates ranging from 2.34 to 300 Mbit/s, where the maximum symbol rate is 75 Msymbol/s. Furthermore, these parameters will be executable in independent burst, dependent burst, or continuous mode. In dependent burst mode the carrier and clock oscillator sources are common from burst to burst. To achieve as broad a set of requirements as these, it is clear that the essential signal processing must be digital. In addition, to avoid hardware changes when the operational parameters are changed, a fixed interface to an analog intermediate frequency (IF) is necessary for transmission; and, common system level architectures are necessary for the modulator and demodulator. Lastly, to minimize size and power, as much of the design as possible will be implemented with application specific integrated circuit (ASIC) chips. Author

N92-14232*# TRW Space Technology Labs., Redondo Beach, CA. Electronic Systems Group.
MULTI-RATE DEMODULATOR ARCHITECTURE
Michael A. Sherry and Gregory S. Caso *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 273-278 (For primary document see N92-14202 05-32)
(Contract NAS3-25866)
Avail: NTIS HC/MF A13 CSCL 17B

A unique digital multi-rate demodulator (MRD) architecture is presented for onboard satellite communications processing. The multi-rate feature enables the same demodulator hardware to process either one wideband channel (WBC), or process up to thirty-two independent narrowband channels (NBC) that are time division multiplexed (TDM). The MRD can process many quadrature modulation format such as offset quadrature phase shift keying (OQPSK). Possible applications include voice and data transmission for commercial or military users. Author

N92-14233*# Hawaii Univ., Manoa. Dept. of Electrical Engineering.
MULTI-STAGE DECODING OF MULTI-LEVEL MODULATION CODES
Shu Lin, Tadao Kasami, and Daniel J. Costello, Jr. (Notre Dame Univ., IN.) *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 279-285 (For primary document see N92-14202 05-32)
(Grant NAG5-931)
Avail: NTIS HC/MF A13 CSCL 17B

Various types of multi-stage decoding for multi-level modulation codes are investigated. It is shown that if the component codes of a multi-level modulation code and types of decoding at various stages are chosen properly, high spectral efficiency and large coding gain can be achieved with reduced decoding complexity. Particularly, it is shown that the difference in performance between the suboptimum multi-stage soft-decision maximum likelihood decoding of a modulation code and the single-stage optimum soft-decision decoding of the code is very small, only a fraction of dB loss in signal to noise ratio at a bit error rate (BER) of 10(exp -6). Author

N92-14234*# California Univ., Davis. Digital Communications Research Lab.
BASEBAND PULSE SHAPING TECHNIQUES FOR NONLINEARLY AMPLIFIED PI/4-QPSK AND QAM SYSTEMS
Kamilo Feher *In* NASA. Lewis Research Center, Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 287-294 (For primary document see N92-14202 05-32)
Avail: NTIS HC/MF A13 CSCL 17B

A new generation of multi-stage pi/4-shifted QPSK and of superposed quadrature-amplitude-modulated (SQAM) modulators-coherent demodulators (modems) and of continuous phase modulated (CPM)-gaussian premodulation filtered minimum-shift-keying (MGMSK) systems is proposed and studied. These modems will lead to bandwidth and power efficient satellite communications systems designs. As an illustrative application, a baseband processing technique pi/4-controlled transition PSK (pi/4-CTPSK) is described. To develop a cost and power efficient design strategy, we assume that nonlinear, fully saturated high power amplifiers (HPA) are utilized in the satellite earth station transmitter and in the satellite transponder. Modem structures which could lead to application specific integrated circuit (ASIC) satellite on-board processing universal modem applications are also considered. Multistate GMSK (i.e., MGMSK) signal generation methods by means of two or more RF combined nonlinearly amplified SQAM modems and by one multistate (in-phase and quadrature-baseband premodulation filtered-superposed) SQAM architecture and one RF nonlinear amplifier are studied. During the SQAM modem development phase we investigate the potential system advantages of the pi/4-shifted logic. The bandwidth efficiency of the proposed multistate GMSK and baseband filtered PAM-FM modulator (a new class in the CPM family) will be significantly higher than that of conventional G-MSK systems. To optimize the practical P(sub e) = f((E sub b)/(N sub o)) performance we consider improved coherent demodulation MGMSK structures such as deviated-frequency locking coherent demodulators. For relative low bit rate SATCOM applications, e.g., bit rates less than 300 kb/s, phase noise tracking cancellation (for fixed site earth station) and phase noise cancellation as well as Doppler compensation (for satellite to mobile earth station) applications may be required. We study digital channel sounding methods which could cancel the phase noise-caused degradations of CPM and GMSK modems. Author

N92-14235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FLEXIBLE DIGITAL MODULATION AND CODING SYNTHESIS FOR SATELLITE COMMUNICATIONS
Mark Vanderaar, James Budinger, Craig Hoerig, and John Tague (Ohio Univ., Athens.) *In its* Space Communications Technology Conference: Onboard Processing and Switching Nov. 1991 p 295-303 (For primary document see N92-14202 05-32)
(Contract NAS3-25266; NAG3-1183)
Avail: NTIS HC/MF A13 CSCL 17B

An architecture and a hardware prototype of a flexible trellis modem/codec (FTMC) transmitter are presented. The theory of operation is built upon a pragmatic approach to trellis-coded

modulation that emphasizes power and spectral efficiency. The system incorporates programmable modulation formats, variations of trellis-coding, digital baseband pulse-shaping, and digital channel precompensation. The modulation formats examined include (uncoded and coded) binary phase shift keying (BPSK), quatenary phase shift keying (QPSK), octal phase shift keying (8PSK), 16-ary quadrature amplitude modulation (16-QAM), and quadrature quadrature phase shift keying (Q squared PSK) at programmable rates up to 20 megabits per second (Mbps). The FTMC is part of the developing test bed to quantify modulation and coding concepts. Author

N92-14236*# National Academy of Sciences - National Research Council, Washington, DC.
INTERNATIONAL GLOBAL NETWORK OF FIDUCIAL STATIONS: SCIENTIFIC AND IMPLEMENTATION ISSUES
1991 142 p Sponsored in part by NASA; AF; DMA; DOE; National Geodetic Survey; and NOAA
(NASA-CR-189525; NAS 1.26:189525; LC-91-62173;
ISBN-0-309-04543-6) Avail: NTIS HC/MF A07 CSCL 14B

In this report, an ad hoc panel of the National Research Council's Committee on Geodesy, Board of Earth Sciences and Resources (1) evaluates the scientific importance of a global network of fiducial sites, monitored very precisely, using a combination of surface- and space-geodetic techniques; (2) examines strategies for implementing and operating such a network; and (3) assesses whether such a network would provide a suitable global infrastructure for geodetic and other geophysical systems of the next century. The panel concludes that a global network of fiducial sites would be a valuable tool for addressing global change issues and play a critical role in providing a reference frame for scientific Earth missions. The panel suggests that existing global networks be integrated and anticipates that such a network would grow from about 30 to the ultimate size of about 200 fiducial sites. It is noted that such a global network will provide a long-term infrastructure for geodetic and geophysical studies. The panel expects that these fiducial sites would evolve into terrestrial observatories or laboratories that would permit more comprehensive studies of the Earth than those now possible.
J.P.S.

N92-14237*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Jul. - Sep. 1991
Edward C. Posner, ed. 15 Nov. 1991 175 p
(NASA-CR-189484; JPL-TDA-PR-42-107; NAS 1.26:189484)
Avail: NTIS HC/MF A08 CSCL 17B

A compilation is presented of articles on developments in programs managed by JPL's Office of Telecommunications and Data Acquisition. In space communications, radio navigation, radio science, and ground based radio and radar astronomy, activities of the Deep Space Network are reported in planning, in supporting research and technology, in implementation, and in operations. Also included is standards activity at JPL for space data and information systems and reimbursable DSN work performed for other space agencies through NASA. In the search for extraterrestrial intelligence (SETI), implementation and operations are reported for searching the microwave spectrum. For individual titles, see N92-14238 through N92-14252.

N92-14238*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A RECEIVER DESIGN FOR THE SUPERCONDUCTING CAVITY-MASER OSCILLATOR **c33**
R. T. Wang and G. J. Dick *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 1-11 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09A

A new frequency standard was demonstrated with the aid of a double phase locked loop (PLL) receiver. A superconducting cavity maser oscillator (SCMO) and a hydrogen maser are combined to show the medium term performance of the hydrogen maser together with improved short term performance made possible by the SCMO. The receiver, which generates a 100 MHz signal with reduced noise, is phase locked to (and may be used in place of) the 100 MHz hydrogen maser output. The maser signal, 2.69xxx-GHz SCMO output, and a 100 MHz quartz crystal oscillator are optimally combined by the receiver. A measured two source fractional frequency stability of 2 x 10(exp -14) was obtained for a measuring time of r = 1 sec, and 1 x 10(exp -15) at r = 1,000 sec. The 1 sec value is approx. 10 times lower than that for hydrogen masers, while the 1,000 sec value is identical to hydrogen maser performance. The design is based on phase noise models for the hydrogen maser, the SCMO, and quartz crystal oscillators for offset frequencies down to 1 x 10(exp -6) Hz. Author

N92-14239*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
SUPPRESSED CARRIER FULL-SPECTRUM COMBINING
D. H. Rogstad *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 12-20 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A technique to accomplish full spectrum arraying where all the telemetry power is put into the subcarrier sidebands (suppressed carrier) is described. The matched filter needed in each antenna prior to cross correlation for deriving the coherence delay and phase offsets is an open loop version of the telemetry phase lock loop provided in the Advanced Digital Receiver. In analogy with a Costas loop telemetry receiver, a squaring loss is derived, and a signal to noise ratio for the cross correlation loop phase is presented. Author

N92-14240*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A COMPARISON OF THE FRACTAL AND JPEG ALGORITHMS **c61**
K.-M. Cheung and M. Shahshahani *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 21-26 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

A proprietary fractal image compression algorithm and the Joint Photographic Experts Group (JPEG) industry standard algorithm for image compression are compared. In every case, the JPEG algorithm was superior to the fractal method at a given compression ratio according to a root mean square criterion and a peak signal to noise criterion. Author

N92-14241*# Johns Hopkins Univ., Baltimore, MD.
A MINIMALIST APPROACH TO RECEIVER ARCHITECTURE
O. Collins *In* JPL, The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 27-35 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

New signal processing techniques are described for Deep Space Network radios and a proposed receiver architecture is presented, as well as experimental results on this new receiver's analog front end. The receiver's design employs direct downconversion rather than high speed digitization, and it is just as suitable for use as a space based probe relay receiver as it is for installation at a ground antenna. The advantages of having an inexpensive, shoe box size receiver, which could be carried around to antennas of opportunity, used for spacecraft testing or installed in the base of every antenna in a large array are the force behind this project.
Author

N92-14242*# Johns Hopkins Univ., Baltimore, MD.
DETERMINATE-STATE CONVOLUTIONAL CODES **c61**
O. Collins and M. Hizlan *In* JPL, The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 36-56 Sponsored in part by NSF (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

A determinate state convolutional code is formed from a conventional convolutional code by pruning away some of the possible state transitions in the decoding trellis. The type of staged

power transfer used in determinate state convolutional codes proves to be an extremely efficient way of enhancing the performance of a concatenated coding system. The decoder complexity is analyzed along with free distances of these new codes and extensive simulation results is provided of their performance at the low signal to noise ratios where a real communication system would operate. Concise, practical examples are provided. Author

N92-14243*# California Univ., Davis.
SOME PARTIAL-UNIT-MEMORY CONVOLUTIONAL CODES
c61
K. Abdel-Ghaffar, R. J. McEliece, and G. Solomon (California Inst. of Tech., Pasadena.) *In* JPL, The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 57-72 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

The results of a study on a class of error correcting codes called partial unit memory (PUM) codes are presented. This class of codes, though not entirely new, has until now remained relatively unexplored. The possibility of using the well developed theory of block codes to construct a large family of promising PUM codes is shown. The performance of several specific PUM codes are compared with that of the Voyager standard (2, 1, 6) convolutional code. It was found that these codes can outperform the Voyager code with little or no increase in decoder complexity. This suggests that there may very well be PUM codes that can be used for deep space telemetry that offer both increased performance and decreased implementational complexity over current coding systems. Author

N92-14244*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
A PORTABLE Ku-BAND FRONT-END TEST PACKAGE FOR BEAM-WAVEGUIDE ANTENNA PERFORMANCE EVALUATION
T. Y. Otoshi, S. R. Stewart, and M. M. Franco *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 73-80 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A 34-m beam-waveguide (BWG) antenna has been built a Deep Space Station 13 (DDS 13) in the Goldstone Deep Space Communications Complex. This antenna is designed to be efficient at X-, Ku-, and Ka-bands, and it is the first NASA tracking antenna to use a BWG design. The design of a Ku-band test package for the new BWG antenna at 11.7-12.2 GHz is presented. Results of linear polarization measurements with the test package on the ground are also presented. This report is the fifth in a series of articles concerned with test package design and performance. Author

N92-14245*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
A PROPOSED FAR-FIELD METHOD FOR FREQUENCY-STABILITY MEASUREMENTS ON THE DSS 13 BEAM-WAVEGUIDE ANTENNA
T. Y. Otoshi *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 81-87 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A method for measuring the frequency stability of the beam-waveguide (BWG) antenna at Deep Space Station 13 is presented. This method is relatively inexpensive and primarily utilizes equipment that is already available. Another desirable feature of the method is that a far-field signal will be used for the measurement. In concert with the goal of employing new technology developments, a fiber optic system will be used at 12 GHz to carry a reference antenna signal to the BWG antenna Ku-band test-package location in the pedestal room. Author

N92-14246*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
THE L-/C-BAND FEED DESIGN FOR THE DSS 14 70-METER ANTENNA (PHOBOS MISSION)
P. H. Stanton and H. F. Reilly, Jr. *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 88-95 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A dual-frequency (1.668 and 5.01 GHz) feed was designed for the Deep Space Network (DSN) 14 70-m antenna to support the Soviet Phobos Mission. This antenna system was capable of supporting telemetry, two-way Doppler, and very long baseline interferometry (VLBI). VLBI and two-way Doppler information on the Phobos spacecraft was acquired with this antenna in 1989. Author

N92-14247*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Guidance and Control Section.
MARK 4A ANTENNA CONTROL SYSTEM DATA HANDLING ARCHITECTURE STUDY
H. C. Briggs and D. B. Eldred *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 96-103 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A high-level review was conducted to provide an analysis of the existing architecture used to handle data and implement control algorithms for NASA's Deep Space Network (DSN) antennas and to make system-level recommendations for improving this architecture so that the DSN antennas can support the ever-tightening requirements of the next decade and beyond. It was found that the existing system is seriously overloaded, with processor utilization approaching 100 percent. A number of factors contribute to this overloading, including dated hardware, inefficient software, and a message-passing strategy that depends on serial connections between machines. At the same time, the system has shortcomings and idiosyncrasies that require extensive human intervention. A custom operating system kernel and an obscure programming language exacerbate the problems and should be modernized. A new architecture is presented that addresses these and other issues. Key features of the new architecture include a simplified message passing hierarchy that utilizes a high-speed local area network, redesign of particular processing function algorithms, consolidation of functions, and implementation of the architecture in modern hardware and software using mainstream computer languages and operating systems. The system would also allow incremental hardware improvements as better and faster hardware for such systems becomes available, and costs could potentially be low enough that redundancy would be provided economically. Such a system could support DSN requirements for the foreseeable future, though thorough consideration must be given to hard computational requirements, porting existing software functionality to the new system, and issues of fault tolerance and recovery. Author

N92-14248*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Office of Telecommunications and Data Acquisition.
EXPECTED ANTENNA UTILIZATION AND OVERLOAD
Edward C. Posner *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 104-112 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

The trade-offs between the number of antennas at Deep Space Network (DSN) Deep-Space Communications Complex and the fraction of continuous coverage provided to a set of hypothetical spacecraft, assuming random placement of the space craft passes during the day. The trade-offs are fairly robust with respect to the randomness assumption. A sample result is that a three-antenna complex provides an average of 82.6 percent utilization of facilities and coverage of nine spacecraft that each have 8-hour passes, whereas perfect phasing of the passes would yield 100 percent utilization and coverage. One key point is that sometimes fewer than three spacecraft are visible, so an antenna is idle, while at other times, there aren't enough antennas, and some spacecraft do without service. This point of view may be useful in helping to size the network or to develop a normalization for a figure of merit of DSN coverage. Author

N92-14249*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
TRAJECTORY AND NAVIGATION SYSTEM DESIGN FOR ROBOTIC AND PILOTED MISSIONS TO MARS c13
S. W. Thurman and S. E. Matousek *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 113-131 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 22A

Future Mars exploration missions, both robotic and piloted, may utilize Earth to Mars transfer trajectories that are significantly different from one another, depending upon the type of mission being flown and the time period during which the flight takes place. The use of new or emerging technologies for future missions to Mars, such as aerobraking and nuclear rocket propulsion, may yield navigation requirements that are much more stringent than those of past robotic missions, and are very difficult to meet for some trajectories. This article explores the interdependencies between the properties of direct Earth to Mars trajectories and the Mars approach navigation accuracy that can be achieved using different radio metric data types, such as ranging measurements between an approaching spacecraft and Mars orbiting relay satellites, or Earth based measurements such as coherent Doppler and very long baseline interferometry. The trajectory characteristics affecting navigation performance are identified, and the variations in accuracy that might be experienced over the range of different Mars approach trajectories are discussed. The results predict that three sigma periapsis altitude navigation uncertainties of 2 to 10 km can be achieved when a Mars orbiting satellite is used as a navigation aid. Author

N92-14250*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A 640-MHz 32-MEGACHANNEL REAL-TIME POLYPHASE-FFT SPECTRUM ANALYZER
G. A. Zimmerman, M. F. Garyantes, M. J. Grimm, and B. Charny *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 132-140 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

A polyphase fast Fourier transform (FFT) spectrum analyzer being designed for NASA's Search for Extraterrestrial Intelligence (SETI) Sky Survey at the Jet Propulsion Laboratory is described. By replacing the time domain multiplicative window preprocessing with polyphase filter processing, much of the processing loss of windowed FFTs can be eliminated. Polyphase coefficient memory costs are minimized by effective use of run length compression. Finite word length effects are analyzed, producing a balanced system with 8 bit inputs, 16 bit fixed point polyphase arithmetic, and 24 bit fixed point FFT arithmetic. Fixed point renormalization midway through the computation is seen to be naturally accommodated by the matrix FFT algorithm proposed. Simulation results validate the finite word length arithmetic analysis and the renormalization technique. Author

N92-14251*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
POLYPHASE-DISCRETE FOURIER TRANSFORM SPECTRUM ANALYSIS FOR THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE SKY SURVEY c55
G. A. Zimmerman and S. Gulkis *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 141-154 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 06C

The sensitivity of a matched filter-detection system to a finite-duration continuous wave (CW) tone is compared with the sensitivities of a windowed discrete Fourier transform (DFT) system and an ideal bandpass filter-bank system. These comparisons are made in the context of the NASA Search for Extraterrestrial Intelligence (SETI) microwave observing project (MOP) sky survey. A review of the theory of polyphase-DFT filter banks and its relationship to the well-known windowed-DFT process is presented. The polyphase-DFT system approximates the ideal bandpass filter bank by using as few as eight filter taps per polyphase branch. An improvement in sensitivity of approx. 3 dB over a windowed-DFT system can be obtained by using the polyphase-DFT approach. Sidelobe rejection of the polyphase-DFT system is vastly superior to the windowed-DFT system, thereby improving its performance in the presence of radio frequency interference (RFI). Author

N92-14252*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
THE BEHAVIOR OF QUANTIZATION SPECTRA AS A FUNCTION OF SIGNAL-TO-NOISE RATIO
M. J. Flanagan (California Inst. of Tech., Pasadena.) *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 155-168 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 17B

An expression for the spectrum of quantization error in a discrete-time system whose input is a sinusoid plus white Gaussian noise is derived. This quantization spectrum consists of two components: a white-noise floor and spurious harmonics. The dithering effect of the input Gaussian noise in both components of the spectrum is considered. Quantitative results in a discrete Fourier transform (DFT) example show the behavior of spurious harmonics as a function of the signal-to-noise ratio (SNR). These results have strong implications for digital reception and signal analysis systems. At low SNRs, spurious harmonics decay exponentially on a log-log scale, and the resulting spectrum is white. As the SNR increases, the spurious harmonics figure prominently in the output spectrum. A useful expression is given that roughly bounds the magnitude of a spurious harmonic as a function of the SNR. Author

N92-14253# Phillips Lab., Kirkland AFB, NM.
IONIZING RADIATION SURVEY Technical Report, Dec. 1990 - Jan. 1991
Kyle J. Hendricks Aug. 1991 10 p
(AF Proj. 5797)
(AD-A240966; AD-E200766; PL-TN-91-1035) Avail: NTIS HC/MF A02 CSCL 06/7

Many of the High Power Microwave sources currently use relativistic electron beams (REB). Typically, the total energy contained in the REB is not converted into microwave energy. This remaining energy will produce an ionizing radiation hazard within our laboratories. This report provides a reference for the calculations and considerations that must be accounted for in the setup for a new experiment. This manuscript will not be exhaustive in detail; however, it is a good reference for new people in our laboratory. GRA

N92-14254# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
THE IMPOSSIBILITY OF IMPLEMENTING RELIABLE COMMUNICATION IN THE FACE OF CRASHES
Alan Fekete, Nancy Lynch, Yishay Mansour, and John Spinelli Sep. 1991 25 p Supersedes MIT/LCS/TM-355.B
(Contracts N00014-85-K-0168; N00014-83-K-0125; N00014-91-J-1046; N00014-89-J-1988)
(AD-A241291; MIT/LCS/TM-355.C; MIT/LCS/TM-355.B) Avail: NTIS HC/MF A03 CSCL 12/5

An important function of communication networks is to implement reliable data transfer over an unreliable underlying network. Formal specifications are given for reliable and unreliable communication layers, in terms of input - output automata. Based on these specifications, it is proved that no reliable communication protocol can tolerate crashes of the processors on which the protocol runs. GRA

N92-14255# Air Force Systems Command, Griffiss AFB, NY. Rome Lab.
MULTICHANNEL DETECTION USING THE DISCRETE-TIME MODEL-BASED INNOVATIONS APPROACH Report, May 1990 - May 1991
James H. Michels Aug. 1991 384 p
(AF Proj. 4506)

(AD-A241331; RL-TR-91-269) Avail: NTIS HC/MF A17 CSCL 12/9

This report makes several contributions. First, an approach is developed to synthesize multichannel autoregressive (AR) random processes allowing for the control of temporal and cross-channel correlation of the processes subject to specific constraints for realizable correlation sequences. Second, analytic expressions are developed for the error variance of time-averaged correlation function estimators for discrete, complex baseband processes. These expressions reveal the functional dependence of the error variance, not only on the window size of the observation interval, but also on fundamental characteristics of the observed processes. Third, model-based likelihood ratios are developed for the multichannel binary detection problem using error vector processes obtained through predicational error filtering operations. These ratios are derived assuming wide-sense stationarity of the baseband Gaussian processes. However, a more general likelihood ratio applicable for nonstationary bandpass processes is also developed. Fourth, the more general likelihood ratio utilized a more powerful estimator than previously noted. GRA

N92-14256# Texas A&M Univ., College Station. Dept. of Electrical Engineering.

RADIATION, SCATTERING, AND GUIDANCE OF ELECTROMAGNETIC FIELDS BY ARBITRARILY SHAPED STRUCTURES EMBEDDED IN LAYERED DIELECTRIC MEDIA Quarterly Progress Report, 1 Jul. - 30 Sep. 1991

Arthur K. Jordan 30 Sep. 1991 1 p

(Contract N00014-90-J-1197)

(AD-A241832) Avail: NTIS HC/MF A01 CSCL 20/14

We continued work on the problem of an arbitrarily shaped microstrip patch antenna excited by a waveguide mode through an aperture of arbitrary shape. An efficient approach to the computation of the waveguide Green's functions, based on a Floquet expansion combined with Poisson acceleration, has been implemented in a computer program and tested. We also continued the study of three-dimensional microstrip discontinuities. As an initial part of this effort, we have implemented an efficient method of computing the spectral domain Green's functions for a layered uniaxial medium. This method is now being applied in the analysis of coplanar waveguide discontinuities. We began work on the problem of single and coupled integrated dielectric waveguides. An approach is being implemented, which combines an integral equation (exterior to the waveguide proper) and finite element (inside the inhomogeneous waveguide) methods. GRA

N92-14257# Ohio State Univ., Columbus. Electroscience Lab.

METHOD OF MOMENTS ANALYSIS OF SCATTERING BY CHIRAL MEDIA

M. S. Kluskens and E. H. Newman Jul. 1991 187 p

(Contract N00014-89-J-1007)

(AD-A241848; ESL-721566-2) Avail: NTIS HC/MF A09 CSCL 20/3

In this report, the interaction of electromagnetic fields with objects composed of chiral media is analyzed using eigenfunction and method of moments techniques. The historical basis for the constitutive relationships of chiral media is presented in the first chapter. The wave equation, volume equivalence theorem, and image theory for chiral media are presented in the second chapter. An eigenfunction solution for scattering by a multilayer circular chiral cylinder with a center cylinder described by an impedance surface is developed in the third chapter. A pulse-basis point-matching method of moments solution for scattering by an inhomogeneous object composed of chiral media in free-space or in the presence of a perfectly conducting half-plane is presented in the fourth chapter. A spectral-domain Galerkin method of moments solution for a microstrip transmission line on a chiral substrate is developed in the fifth chapter. Numerical data in each case demonstrated that the chirality of the objects causes a significant asymmetry in the electromagnetic fields, which is not present for achiral objects. GRA

N92-14258# Department of the Navy, Washington, DC.

A METHOD AND APPARATUS FOR SIGNAL PREDICTION IN A TIME-VARYING SIGNAL SYSTEM Patent Application

Kam W. Ng, inventor (to Navy) 27 Mar. 1991 21 p

(AD-D015021; US-Patent-Appl-SN-678580) Avail: NTIS HC/MF A03 CSCL 12/1

A method and apparatus for signal prediction using the estimate-maximize (EM) algorithm in a time-varying signal system is provided. A time function is used to appropriately weight, in complementary fashion, the significance of both the complete and incomplete data sets used by the EM algorithm over a time period of interest. Initially, the EM solution is based solely on the complete data set. As time progresses, the significance of the complete data set in the solution decreases while the significance of the incomplete data set increases. By the end of the time period of interest, the EM solution is based solely on the incomplete data set. The rate of decrease of significance of the complete data set, and complementary increase in significance of the incomplete data set, are controlled by the characteristics of the time function. The method is particularly useful in the area of active noise control where an open-loop response is provided by off-line predictive models of the time-varying noise signals to form the complete set and where a closed-loop adaptive response forms the incomplete data set. GRA

N92-14259# International Centre for Theoretical Physics, Trieste (Italy).

LIMITATIONS IN TRANSMITTER-RECEIVER DISTANCES FOR TERRESTRIAL MICROWAVE TRANSMISSIONS

E. C. Njau Dec. 1990 10 p

(DE91-635167; IC-90/438) Avail: NTIS HC/MF A02

Directional microwave repeater systems are still in significant use for radio-telephone communications as well as terrestrial TV transmissions. In these systems, the optimally maximum distance D(sub 0) between one transmitter and the next repeater-receiver partly depends on meteorological conditions since the refractive index n for microwaves is considerably influenced by these conditions. We show that, under dry atmospheric conditions, certain zonally travelling heat/temperature waves which are normally in the weather/climate system significantly vary n and hence inevitably impose specific conditions on the evaluation of D(sub 0). Finally we use some Tanzanian meteorological records to arrive at an expression for D(sub 0) that is suitable for regions whose meteorological conditions are comparable to those in Tanzania. DOE

N92-14260# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

BASIC PROCEDURE OF MEASURING THE RELATIVISTIC LENGTH AND ITS MODIFICATIONS

V. N. Streltsov 1989 4 p In RUSSIAN; ENGLISH summary

(DE91-628072; JINR-R-2-89-5) Avail: NTIS HC/MF A01

The radar method for distance measurement serves a base for the relativistic length concept (CRL), which consequence is the elongation formula. Possible modifications of this basic measuring procedure are considered. The first one is based on the existence of objects pulsing or synchronously radiating the signals (in the proper object reference system). The second modification is based on using the visual sizes of fast-moving bodies. Finally, the latter way is connected with measuring the time-of-flight of an object (rod) and its velocity. DOE

N92-14261*# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.

DEVELOPMENT OF THEORETICAL MODELS OF INTEGRATED MILLIMETER WAVE ANTENNAS Final Report, 20 Aug. 1986 - 19 Aug. 1989

K. Sigfrid Yngvesson and Daniel H. Schaubert Washington NASA. Langley Research Center Dec. 1991 93 p

(Contract NAS1-18310)

(NASA-CR-4417; NAS 1.26:4417) Avail: NTIS HC/MF A05 CSCL 20N

Extensive radiation patterns for Linear Tapered Slot Antenna

(LTSA) Single Elements are presented. The directivity of LTSA elements is predicted correctly by taking the cross polarized pattern into account. A moment method program predicts radiation patterns for air LTSAs with excellent agreement with experimental data. A moment method program was also developed for the task LTSA Array Modeling. Computations performed with this program are in excellent agreement with published results for dipole and monopole arrays, and with waveguide simulator experiments, for more complicated structures. Empirical modeling of LTSA arrays demonstrated that the maximum theoretical element gain can be obtained. Formulations were also developed for calculating the aperture efficiency of LTSA arrays used in reflector systems. It was shown that LTSA arrays used in multibeam systems have a considerable advantage in terms of higher packing density, compared with waveguide feeds. Conversion loss of 10 dB was demonstrated at 35 GHz. Author

N92-14262*# Ohio State Univ., Columbus. ElectroScience Lab.
SATCOM ANTENNA SITING STUDY ON P-3C AIRCRAFT, VOLUME 1 Final Report
D. A. Bensman and R. J. Marhefka Sep. 1991 198 p
(Grant NAG2-542)
(NASA-CR-189514; NAS 1.26:189514; FR-721711-4-Vol-1) Avail: NTIS HC/MF A09 CSCL 20N

The NEC-BSC (Basic Scattering Code) was used to study the performance of a SATCOM antenna on a P-3C aircraft. After plate cylinder fields are added to version 3.1 of the NEC-BSC, it is shown that the NEC-BSC can be used to accurately predict the performance of a SATCOM antenna system on a P-3C aircraft. The study illustrates that the NEC-BSC gives good results when compared with scale model measurements provided by Boeing and Lockheed. Author

N92-14263*# Ohio State Univ., Columbus. ElectroScience Lab.
SATCOM ANTENNA SITING STUDY ON P-3C AIRCRAFT, VOLUME 2 Final Report
D. A. Bensman and R. J. Marhefka Sep. 1991 193 p
(Grant NAG2-542)
(NASA-CR-189515; NAS 1.26:189515; FR-721711-4-Vol-2) Avail: NTIS HC/MF A09 CSCL 20N

This volume contains an antenna location study for the P-3C aircraft. From this location study, a determination can be made of the complete antenna system required to achieve the desired pattern and polarization coverage. The antenna used is the same Batwing airborne UHF satellite communications antenna use in volume 1. The aircraft model used in the majority of the locations studied is the simple cylindrical aircraft model defined in volume 1. Author

N92-14264# Lawrence Livermore National Lab., CA.
GROUND WAVE PROPAGATION OF A VIDEO PULSE SOURCE, PART 2
K. A. Dreyer and H. M. Buettner 19 Jul. 1991 17 p
(Contract W-7405-eng-48)
(DE92-001794; UCRL-ID-108066) Avail: NTIS HC/MF A03

In a previous paper we developed a simple model describing the far-field from a video-pulse source near the ground and for grazing incidence. We report here on a recent field test in which we attempted to verify the model. Our results show quantitative agreement with the model for most of the tested parameter space. We have also extended our model to include all elevation angles, including up to vertical. The computed engagement envelope shows three distinct regions: At grazing angles the field is small and diminishes to near zero at the earth's surface; at low-to moderate angles strong lobing occurs; at high angles the video-pulse field approaches its free-space form. DOE

N92-14265# Oak Ridge National Lab., TN.
NUMERICAL MODELLING OF THE TFTR ICRH ANTENNAS
M. Kress, Y. L. Ho, W. Grossmann, A. Drobot, D. B. Batchelor, P. M. Ryan, and M. Carter 1991 6 p Presented at the 9th Topical Conference on Radio Frequency Power in Plasmas, Charleston, SC, 12-14 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE92-002061; CONF-910869-18) Avail: NTIS HC/MF A02

A general purpose 3D electromagnetic field solver code, ARGUS, is being used to analyze the TFTR Antennas. To date, the vacuum radiation patterns produced by the bay M and L antennas have been obtained and reported. Recent work has concentrated on antenna performance comparison and understanding the role of geometry on performance (e.g., the impact of end-effects on current 2D models). Additional diagnostics such as evaluation of phase velocity and strap inductance are being implemented to enhance our understanding and to better compare with measurements. DOE

N92-14266# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
A MULTI-MEDIA MULTI-USER SERVICE FOR THE B-ISDN
Geert J. Heijenk, Marcel A. Jordense, Richard A. Sturrus, and Ignas G. Niemegeers 19 Jun. 1991 14 p
(Memo-INF-91-56; TIOS-91/023; ISSN-0923-1714; ETN-92-90516)
Avail: NTIS HC/MF A03

Much effort is currently being invested in the design of the Broadband-Integrated Services Digital Networks (B-ISDN). A description of the required functional behavior of the B-ISDN, in the form of an abstract and unambiguous service specification, is required as a common reference for the design. A first version of such a service specification, not available up to now, is provided. The presented service provides multimedia and multiuser communications. A call model, which underlies the description of the service is presented. It utilizes the concept of service component. A service component is characterized by its information type and the functions it performs on the information. In the actual service description, service primitives, their parameters, and their mutual relations (i.e., possible sequences) are given. Examples illustrate that it is easy to establish a simple telephone call, but that more complex calls have the inherent property that their establishment requires a lot of interactions between the communication system and its users. ESA

N92-14267# Royal Signals and Radar Establishment, Malvern (England). Electronics Div.
ELECTROMAGNETIC SCATTERING BY THE DELTA BOUNDARY OPERATOR METHOD
I. D. King Jul. 1991 61 p
(RSRE-Memo-4502; BR303456; ETN-92-90697) Copyright
Avail: NTIS HC/MF A04

The wider applicability of approximate delta boundary operator techniques is investigated. The delta boundary operator technique is in an alternative and rigorous formulation of electromagnetic scattering; and the use of a simple approximation allows fast and accurate calculation of scattering by rough planer surfaces. Attention is focused on scattering by simple smooth bodies in the so called resonance region, where the approximations of high frequency asymptotic techniques are often inadequate. It is shown that application of approximate delta boundary operator methods leads to predictions of non vanishing surface currents in unit regions and smooth transition currents at shadow boundaries. ESA

N92-14268# European Space Agency, Paris (France). Standards Approval Board for Space Data Communications.
RANGING STANDARD. VOLUME 1: DIRECT GROUND TO SPACECRAFT RANGING
Mar. 1991 38 p
(ESA-PSS-04-104-Vol-1-Issue-2; ISSN-0379-4059; ETN-92-90323)
Copyright Avail: NTIS HC/MF A03

Single access range and Doppler tracking on direct links between spacecraft of category A or category B missions and Earth based stations, are considered. The ranging standard is applicable to all ESA spacecraft that are supported for range or Doppler tracking by direct links to ESA controlled Earth stations operating in the Space Operations Service. Requirements concerning spacecraft transponders and Earth station equipment for the purposes of range and Doppler tracking are defined. Criteria

by which one may determine the extent to which the accuracy of the measurements is influenced by equipment effects is provided. ESA

N92-14269# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Hochfrequenzphysik.
RADIATION FROM A DIPOLE ANTENNA INTO AN INHOMOGENEOUS, COMPREHENSIBLE, AND NONLINEAR SPACE-PLASMA Ph.D. Thesis - Ruhr Univ.
Karl-Heinz Bethke Jan. 1991 186 p In GERMAN; ENGLISH summary Translation was announced as ESA-TT-1261
(DLR-FB-91-05; ISSN-0939-2963; ETN-92-90325) Avail: NTIS HC/MF A09; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 64 DM

At high electrical field strengths, especially near the antenna feeding point, a plasma behaves like a nonlinear medium. Therefore, nonlinear plasma acts on the antenna nearfield parameters such as current distribution and input impedance. Nonlinear plasma effects on characteristic antenna parameters are investigated. Critical threshold values for the electrical field strength are derived which define the transition from linear to nonlinear plasma. From the fundamental electrodynamic and hydrodynamic equations an exact integral representation for the coupled electromagnetic and electron acoustic waves are derived from a formulation of a boundary value problem for a dipole antenna in a compressible, inhomogeneous plasma. Within the scope of a perturbation theory, numerical results are presented for a dipole in a nonlinear plasma. The formation of an ion sheath as a result of nonlinear antenna-plasma interactions is of fundamental importance for all further calculations. ESA

N92-14270# Federal Aviation Administration, Atlantic City, NJ.
DATA MULTIPLEXING NETWORK (DMN) PHASE 3 EQUIPMENT OPERATIONAL TEST AND EVALUATION (OT AND E)/INTEGRATION TEST REPORT
Wayne E. Bell Dec. 1991 123 p
(DOT/FAA/CT-TN91/50) Avail: NTIS HC/MF A06

This test report contains the results of the Operational Test and Evaluation (OT&E)/Integration testing of the Data Multiplexing Network (DMN) Phase 3 B Commercial Off-The-Shelf (COTS) Equipment. The OT&E/Integration testing was accomplished by conducting unit level tests at the Federal Aviation Administration (FAA) Technical Center, and integration tests at the key test sites of Albuquerque, New Mexico; Minneapolis, Minnesota; and Denver, Colorado, Air Route Traffic Control Centers (ARTCC's). The FAA-E-2786 Verification Requirement Matrix (VRTM) and NAS-SS-1000, Volumes 1 and 4, were verified during OT&E/Integration. Also, the test results determined the operational effectiveness and suitability of the Motorola Codex COTS equipment in the National Airspace System (NAS) environment. Based on the test results, it is concluded that the Motorola Codex COTS equipment performed its function of providing data exchange between NAS facilities and is considered qualified for operational development. Author

N92-14271# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
STEPWISE REFINEMENT OF REACTIVE PROCESSOR FARMS
Kaisa Sere Jun. 1991 20 p Sponsored in part by Technology Development Centre of Finland, and Netherlands Organization for Scientific Research
(RUU-CS-91-17; ISSN-0924-3275; ETN-92-90481) Avail: NTIS HC/MF A03

A processor farm is a distributed system that consists of a unique master processor together with a number of identical slave processors. The master processor interacts with some environment that generates tasks to be solved by the slave processors. The processors are connected via some communication network that takes care of the communication of the tasks between the master and the slaves. The use of a combination of action systems and the refinement calculus to formally derive, in a step wise manner, a communication network and protocol between the processors forming an arbitrary processor farm, is shown. ESA

N92-13971*# Academy of Sciences (USSR), Moscow. Inst. for Problems in Mechanics.
INVERSE PROBLEMS IN DIFFRACTION
Andrew G. Mikheev and Aleksey S. Shamaev *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 563-572 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20N

N92-14026# McMaster Univ., Hamilton (Ontario).
RADAR VISION
Simon Haykin *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 77-80 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

N92-14030# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
COHERENT DETECTION OF INTERLEAVED TRELLIS ENCODED CPFSK FOR SHADOWED MOBILE SATELLITE CHANNELS
Ron W. Kerr and P. J. McLane *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 112-117 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N92-14272# National Advisory Committee on Semiconductors, Arlington, VA.
CAPITAL INVESTMENT IN SEMICONDUCTORS: THE LIFEBLOOD OF THE US SEMICONDUCTOR INDUSTRY
William F. Finan (Quick, Finan and Associates, Inc., Washington, DC.) Sep. 1990 36 p
(PB91-165902) Avail: NTIS HC/MF A03 CSCL 09C

An analysis is given of four proposals designed to improve capital formation for U.S. industry in general, and the semiconductor industry in particular. The National Advisory Committee on Semiconductors recommendations were to make the current research and experimentation (R and E) tax credit more effective, to reduce taxes on capital gains, to increase personal savings incentives, and to improve semiconductor manufacturing equipment depreciation rules. The results of the qualitative analysis of the proposals as well as a description of the methodology employed are given. Author

N92-14273# Sandia National Labs., Albuquerque, NM.
TRANSFER IMPEDANCE OF COAXIAL CABLES
H. Ochem (Siemens and Halske A.G., Berlin, Germany, F.R.) May 1991 41 p
(Contract DE-AC04-76DP-00789)
(DE91-018411; ALS/TR-91-005) Avail: NTIS HC/MF A03

This paper concerns the transfer impedance as a crucial parameter for the effect of external radio-frequency fields on coaxial cables. Calculation and measurement of transfer impedances for closed tubes, shields resolved into strips, and two-layer shields are involved (for the example of wideband cable). Mutual transfer impedance as a measure of crosstalk between adjacent coaxial cables is also discussed. DOE

N92-14274# Range Commanders Council, White Sands Missile Range, NM.
GENERAL PRINCIPLES OF DIGITAL FILTERING AND A SURVEY OF FILTERS IN CURRENT RANGE USE
Aug. 1991 188 p Supersedes RCC-155-71
(AD-A240984; RCC-155-71) Avail: NTIS HC/MF A09 CSCL 09/1

This document catalogues some types of digital filters widely used by the Range Commanders Council (RCC) member ranges. Additionally, the principles behind the filters and application specific design techniques are explored. GRA

N92-14275# Aerospace Corp., El Segundo, CA. Electronics Research Lab.
FINE-STRUCTURE ARTIFACT OF THE VELOCITY DISTRIBUTION OF Cs BEAM TUBES AS MEASURED BY THE PULSED MICROWAVE POWER TECHNIQUE
W. A. Johnson, S. K. Karuza, and F. J. Voit 15 Oct. 1990 16 p
(Contract F04701-88-C-0089)
(AD-A241078; TR-0090(5925-08)-2; SSD-TR-90-39) Avail: NTIS HC/MF A03 CSCL 14/2

An artifact of the pulsed microwave power technique used to measure the velocity distributions of Cs beam tubes is a fine structure on the distribution. In previously reported measurements the signal-to-noise ratio was not high enough to show this structure clearly. This paper presents results that show this structure in detail. To predict these results, a simple theory has been used that considers the Ramsey response function (i.e., output tube current vs microwave frequency) as being a simple electrical-filter transfer function for the input of the pulse-modulated microwave power. Calculations that assume the principle of superposition give predictions that are in close agreement with the measured results. This theory also predicts how to set the pulse width so that the fine-structure artifact is minimized. GRA

N92-14276# Laser Science, Inc., Ames, IA.
LASER DEPOSITION OF CUBIC BORON NITRIDE ON ELECTRONIC MATERIALS Progress Report, 15 Aug. - 14 Sep. 1991
Arul Molian and P. Molian 12 Sep. 1991 21 p
(Contract N00014-91-C-0102)
(AD-A241126) Avail: NTIS HC/MF A03 CSCL 09/1

This progress report describes the initial favorable results of what probably will become a viable method for the deposition of cubic BN on silicon substrate. During this study, energy fluence of laser beam and the target material (type, form, purity eta.) were identified to be the two most critical parameters. In the past month, we have attempted two procedures to synthesize cubic BN: dual-beam laser ablation of a high purity, sintered hexagonal BN (HBC) grade from Union Carbide, and single-beam laser ablation of a high purity, CVD grown pyrolytic BN. Raman and IR spectroscopy as well as X-ray diffraction analysis of films indicated some evidence of cubic BN. Additional work is to be done in order to optimize the procedure such that only cubic form of BN will by grown. GRA

N92-14277# Catholic Univ. of America, Washington, DC. Dept. of Physics.
COMPUTATIONAL METHODS FOR SUPERLATTICE STRUCTURES: RENORMALIZATION AND RECURSION TECHNIQUES Final Report
Lorenzo Resca 9 Sep. 1991 17 p
(Contract DAAB07-86-C-F114)
(AD-A241176) Avail: NTIS HC/MF A03 CSCL 09/1

We summarize in this final report the main results and findings of the theoretical study of the electronic structure of superlattices which we have performed. In recent years there has been an explosion of interest in the experimental and theoretical study of the electronic properties of superlattices, related heterostructures and quantum wells, as well as two-dimensional structures and surfaces in general. The reason of such attention is certainly not a matter of fashion: there are deep motivations and ambitious perspectives. The importance of the electronic and optical properties of superlattices is best appreciated within the general framework of the study of quantum electronic microstructures, i.e., systems where the electronic wavelength becomes comparable to the size of the alternating layers which form the superlattices structure. GRA

N92-14278# Rockwell International Corp., Thousand Oaks, CA.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF HETEROJUNCTION INTERFACES Final Report, 1 Dec. 1984 - 31 Dec. 1990
E. A. Kraut, R. W. Grant, and J. R. Waldrop Feb. 1991 144 p
(Contract N00014-85-C-0135)
(AD-A241243; SC5498-FR) Avail: NTIS HC/MF A07 CSCL 09/1

Heterojunction energy-band discontinuities offer the device designer additional control over electron and hole transport near p-n junctions. Heterojunctions are used to develop new types of solid-state electron devices with properties not available from homojunction based technology. We have developed an experimental technique, based on the use of x-ray photoelectron spectroscopy (XPS), that enables us to measure band offsets to a precision of +/- 0.04 eV and to measure changes in band offsets to a precision of +/- 0.01 eV. With the aid of this powerful experimental approach, we have been able to investigate the following new areas in heterojunction physics: crystallographic orientation dependence of band offsets; growth sequence variation; nontransitivity; and time dependent shifts in band offsets. GRA

N92-14279 Department of the Navy, Washington, DC.
INSULATOR ASSISTED SELF-ALIGNED GATE JUNCTION Patent
Richard Nguyen, inventor (to Navy) 30 Apr. 1991 8 p Filed 30 Oct. 1990
(AD-D014995; US-Patent-5,011,785; US-Patent-Appl-SN-605623; US-Patent-Class-437-41) Avail: US Patent and Trademark Office CSCL 09/1

A high transconductance, low capacitance, low leakage compound semiconductor junction field effect transistor (JFET) enhances the low leakage current while having the advantages of a self-aligned JFET including low capacitance and low source-drain resistance. The diffused junction of the JFET is totally covered during the process of manufacture. An n-channel on a substrate has a layer of photoresist placed over it and exposed to leave a predefined pattern of photoresist. The patterned photoresist is used as a mask so that part of the n-channel layer is etched down to a desired depth leaving a wedge-shaped region. A layer of insulator, such as silicon dioxide, is deposited over the entire substrate and sides of the w edge-shaped region in insulator regions. Next, the photoresist is then removed. A p(+) diffusion or implant is performed in the wedge-shaped region to create a p(+) n-junction system which is the gate region of the JFET. The p(+) n-junction system sides are covered with insulator regions of silicon dioxide unlike the opened-junction of the conventional self-aligned gate JFET. Next, the gate patterned metal is deposited on top of the p(+) n-junction system and partially on the silicon dioxide insulator regions. Using the patterned gate metal as a mask, the silicon dioxide layer is removed. Source and drain metals are then self-aligned evaporated. The JFET has potential use in microwave, millimeter-wave and optical electronic circuits. Author (GRA)

N92-14280 Department of the Navy, Washington, DC.
EDGE-EMITTING DIODE-TO-OPTICAL FIBER COUPLING TECHNIQUE Patent
Donald J. Albares, inventor (to Navy) 16 Apr. 1991 11 p Filed 13 Apr. 1990
(AD-D014997; US-Patent-5,007,700; US-Patent-Appl-SN-509107; US-Patent-Class-350-9617) Avail: US Patent and Trademark Office CSCL 20/6

An aligned and spaced-apart end-on optical coupling is provided between the end of a single mode optical fiber and the emitting aperture of an edge-emitting diode mounted on a heat sink secured to a base. A V-shaped grooved semiconductor chip is mounted

on the base a distance from the edge-emitting diode and a UV curable optical cement is applied in the V-shaped groove and on a lateral surface of the optical fiber. If desired, a coarse alignment can be effected at this stage to position the fiber. The optical fiber is placed in the V-shaped groove to present an overhanging portion so that the UV curable optical cement contacts an end support secured to the edge-emitting diode. The optical fiber is displaced to a position of a desired optical alignment and predetermined separation between end of the optical fiber and the emitting aperture by a hypodermic needle-sized vacuum chuck coupled to the overhanging portion of the optical fiber. A micromanipulator displaces the chuck to effect the desired optical alignment and separation and UV energy is radiated on the UV curable optical cement in the V-shaped groove and on the lateral surface of the optical fiber where it comes in contact with the bearing surface of the end support to secure the fiber in its aligned and spaced-apart relationship. GRA

N92-14281 Department of the Navy, Washington, DC.
ELECTRICAL POWER SUPPLY FOR SHORT TERM POWER INTERRUPTIONS Patent
Russell E. Hammond, inventor (to Navy), Robert L. Northup, inventor (to Navy), Alan G. Shimp, inventor (to Navy), and Francis B. Fassnacht, inventor (to Navy) 30 Apr. 1991 12 p Filed 22 Mar. 1990
(AD-D014998; US-Patent-5,012,121; US-Patent-Appl-SN-497464; US-Patent-Class-367-64) Avail: US Patent and Trademark Office CSCL 10/2

A direct current power supply for instantaneously providing tens of kilowatts of electrical energy for brief periods, such as 100 ms, during momentary power interruptions between a load and an electrical power source having a supply voltage includes a capacitor having an initial voltage charge preferably greater than the supply voltage. The cathode of a Zener diode is operably coupled to the capacitor. The anode of a second diode is operably coupled to the anode of the zener diode. A solid state switch has a power input operably coupled between the capacitor and the cathode of the zener diode, a power output operably coupled between the anodes of the zener diode and second diode, and an enabling input, so that the switch may be triggered to conduct electrical power whereby voltage from the capacitor is conducted through the switch to the anode of the second diode when an enabling signal is provided to the enabling input. The anode of a third diode is operably coupled to the voltage supply, and the cathode of the third diode is connected to the load. The cathode of the second diode is connected between the cathode of the third diode and the load. GRA

N92-14282# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
APPLICATIONS OF REAL-TIME FTIR SPECTROSCOPY TO THE ELUCIDATION OF COMPLEX ELECTROORGANIC PATHWAYS: ELECTROOXIDATION OF ETHYLENE GLYCOL ON PLATINUM, GOLD, AND NICKEL IN ALKALINE SOLUTION
S. C. Chang, Y. Ho, and M. J. Weaver Oct. 1991 36 p
(Contract N00014-91-J-1409)
(AD-A241797; TR-111) Avail: NTIS HC/MF A03 CSCL 09/1

The electrooxidation pathways of ethylene glycol in alkaline aqueous solution on gold, platinum, and nickel electrodes are explored by means of real-time FTIR spectroscopy in conjunction with cyclic voltammetry. The former enables a quantitative assay of specific intermediates and products formed during the reaction evolution. The electrooxidation on gold features the successive formation of partially oxidized C2 solution species on route to oxalate and carbonate production. The latter species is produced predominantly via the formation of the dialdehyde, glyoxal, based on comparisons with electrooxidative spectral sequences for candidates intermediate species. In contrast, ethylene glycol electrooxidation on platinum exhibits markedly different kinetics and product distributions to those for the partially oxidized C2 species, inferring that at least carbonate production from ethylene glycol occurs largely through sequences of chemisorbed, rather than solution-phase, intermediates. GRA

N92-14283# California Univ., San Diego, La Jolla. Dept. of Electrical and Computer Engineering.
SYNTHESIS OF MISMATCHED HETEROJUNCTION/SUBSTRATE INTERFACES Final Report, 1 Jun. 1989 - 31 May 1991
H. H. Wieder 11 Oct. 1991 123 p
(Contract N00014-89-J-2023)
(AD-A241845) Avail: NTIS HC/MF A06 CSCL 09/1

Strained layer InGaAs and InAlAs structures have been grown by molecular beam epitaxy on lattice-mismatched GaAs substrates in order to examine various material properties which may be utilized advantageously for certain devices. The emphasis has been placed on the development of a heterojunction insulated-gate field effect transistor (HIGFET) using lattice-mismatched InGaAs and InA1 As layers to demonstrate the effective utilization and advantages of strained layers. GRA

N92-14284# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
VORTEX RESPONSE, DIMENSIONALITY AND FLUCTUATIONS IN HIGH-T(SUB c) SUUPERCONDUCTORS Final Technical Report, 15 Jul. 1988 - 30 Sep. 1991
John M. Graybeal 30 Sep. 1991 18 p
(Contract N00014-88-K-0479)
(AD-A241850) Avail: NTIS HC/MF A03 CSCL 20/3

This final report encompasses the following research results: In-situ reactive sputter deposition of nanometer-smooth superconducting BSCCO thin films; New method of ozone detection for use with reactive thin-film growth; Fabrication of and detailed noise properties of thin-film dc BSCCO SQUIDs; Power-law scaling of the longitudinal and transverse Hall resistivities due to vortex motion in YBCO, with implications for the nature of the vortex state; Measurement of the ac screening response of 2212 BSCCO crystals, and interpretation within electromagnetic skin depth effects; Vortex flux creep and high-magnetic-field critical currents of epitaxial YBCO thin films. GRA

N92-14285# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
THE LOW FIELD ELECTRODYNAMICS OF HTSC
S. L. Ginzburg 1990 62 p In RUSSIAN; ENGLISH summary
(DE91-637000; LIYaF-1615) Avail: NTIS HC/MF A04

This review summaries the main theoretical conceptions on reversible and irreversible phenomena of low field electrodynamics in usual, current and resistive states of HTSC. DOE

N92-14286# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
EXCESS NOISE OF SECONDARY EMISSION IN THE FREQUENCY RANGE OF (10(EXP -3) - 10(EXP -1)) Hz
V. V. Sushkov and R. S. Shuvalov 1990 11 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE91-639556; IFVE-ONF-90-152) Avail: NTIS HC/MF A03

Study of excess current fluctuations of photomultipliers in the (10(exp -3) to 10(sup -1)) Hz frequency range was conducted. Spectral density and amplitude distribution of current fluctuations in the photomultipliers of two types for several intervals of the frequency range considered were measured. To fit the experimental data the hypothesis of excess noise appearance in photomultipliers was proposed. This hypothesis considers the effect of electron storage on the inner dielectric surface of photomultiplier tube with sequential electric potential from change resulting from charge transfer along the dielectric surface in the external electric field. The current which appeared in the outer circuit as a result of this charge transfer is a random value responsible for the exess fluctuations appearance DOE

N92-14287# Fermi National Accelerator Lab., Batavia, IL.
PERFORMANCE OF A NEW MONOLITHIC EIGHT CHANNEL CHARGE SENSITIVE PREAMPLIFIER-SHAPER
T. Zimmerman Aug. 1991 10 p
(Contract DE-AC02-76CH-03000)
(DE92-000599; FNAL-TM-1754) Avail: NTIS HC/MF A02

A monolithic eight channel CMOS time-invariant preamplifier/shaper has been designed and built by Chuck Britton of ORNL in collaboration with Ray Yarema and Tom Zimmerman of Fermilab. Each of the eight channels incorporates a charge sensitive preamplifier and two shaping stages. The resultant weighting function is similar to CR-RC(exp 3). The peaking time is approx. 200 ns, and the charge gain approx. in the range of 50 to 70 mv/fc. The layout was done on a Tinychip pad frame and the device was fabricated in a 2 micron P-well process by Orbit. The chip layout is shown. The channels are on an 84 micron pitch to fit on a Tinychip without folding the layout. The design can be easily expanded to a larger number of channels. This paper describes results of tests performed on this device at Fermilab. The tests were done with a bare die which was directly wirebonded to a printed circuit board. This minimizes parasitic effects which can become significant when using large packages. Results may be somewhat different when using the standard 40 pin package. DOE

N92-14288# Sandia National Labs., Albuquerque, NM.
CHARACTERISTICS AND DEVELOPMENT REPORT FOR THE MC3246A THERMAL BATTERY
G. L. Scharrer, F. P. R. Lasky, and L. M. Moya Sep. 1991 20 p
(Contract DE-AC04-76DP-00789)
(DE92-000609; SAND-91-0130) Avail: NTIS HC/MF A03

This report describes the design intent, design considerations, system use, development, product characteristics, and early production history of the MC3246A Thermal Battery. This battery has a required operating life of 50 ms above 18.0 V across a 0.68 ohm load. The MC3246A employs the Li(Si/-LiBr-LiCl-LiF/FeS2 electrochemical system. The battery is a hermetically sealed right circular cylinder, 51 mm long and 38 mm in diameter. The mass of the battery is 176 grams. The battery was designed and developed to replace the MC3246 (used on the B83 and B61-7 Preflight Controllers) and to provide the power needed by the Preflight Controllers for the B61-6,8 and the B90. This is the first DOE thermal battery to use the all-lithium electrolyte. DOE

N92-14289# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
POLYMERIC ELECTROLYTES FOR AMBIENT TEMPERATURE LITHIUM BATTERIES
G. C. Farrington Jul. 1991 18 p Prepared for California Univ., Berkeley. Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00098)
(DE92-000711; LBL-31078) Avail: NTIS HC/MF A03

A new type of highly conductive Li(+) polymer electrolyte, referred to as the Innovision polymer electrolyte, is completely amorphous at room temperature and has an ionic conductivity in the range of 10(exp -3) S/cm. This report discusses the electrochemical characteristics (lithium oxidation and reduction), conductivity, and physical properties of Innovision electrolytes containing various dissolved salts. These electrolytes are particularly interesting since they appear to have some of the highest room temperature lithium ion conductivities yet observed among polymer electrolytes. DOE

N92-14290# California Univ., Berkeley. Lawrence Berkeley Lab.
MICRO-SCALE MASS-TRANSFER VARIATIONS DURING ELECTRODEPOSITION Ph.D. Thesis
D. P. Sutija Aug. 1991 304 p
(Contract DE-AC03-76SF-00098)
(DE92-000907; LBL-30825) Avail: NTIS HC/MF A14

Results of two studies on micro-scale mass-transfer enhancement are reported. First, profiled cross-sections of striated zinc surfaces deposited in laminar channel flow were analyzed with fast-fourier transforms (FFT) to determine preferred striation wavelengths. Striation frequency increases with current density until a minimum separation between striae of 150 microns is reached. Beyond this point, independent of substrate used, striae meld together and form a relatively smooth, nodular deposit. Substrates equipped with artificial micron-sized protrusions result in significantly different macro-morphology in zinc deposits. Micro-patterned electrodes (MPE) with hemispherical protrusions 5 microns in diameter yield thin zinc striae at current densities that ordinarily produce random nodular deposits. MPEs with artificial hemi-cylinders, 2.5 microns in height and spaced 250 microns apart, form striae with a period which matches the spacing of micron-sized ridges. Second, a novel, corrosion-resistant micromosaic electrode was fabricated on a silicon wafer. Measurements of mass-transport enhancement to a vertical micromosaic electrode caused by parallel bubble streams rising inside of the diffusion boundary-layer demonstrated the presence of two co-temporal enhancement mechanisms: surface-renewal increases the limiting current within five bubble diameters of the rising column, while bubble-induced laminar flows cause weaker enhancement over a much broader swath. The enhancement caused by bubble curtains is predicted accurately by linear superposition of single-column enhancements. Two columns of smaller H2 bubbles generated at the same volumetric rate as a single column of larger bubbles cause higher peak and far-field enhancements. DOE

N92-14291# Argonne National Lab., IL.
RECENT ADVANTAGES IN PROCESSING AND FABRICATION OF CERAMIC SUPERCONDUCTORS
U. Balachandran, R. B. Poeppel, W. A. Ferrando, S. D. Karmarkar, J. Kerr, P. W. Hess, and A. P. Divecha Aug. 1991 29 p Presented at the NATO Advanced Study Institute on Physics and Materials Science of High-Temperature Superconductors, Corfu Island, Greece, 18-31 Aug. 1991
(Contract W-31-109-eng-38)
(DE91-018548; ANL/CP-73535; CONF-910860-1) Avail: NTIS HC/MF A03

The properties of ceramic superconductors are greatly influenced by the temperature, heating rate, pressure, and gas atmosphere used during processing and fabrication. For example, transport critical current density decreases drastically in the presence of trace amounts of CO2 in the sintering atmosphere. The grain boundaries of samples sintered in O2 atmospheres containing various levels of CO2 have been thoroughly characterized by high-resolution electron microscopy. Reduced total pressure during binder removal and sintering was found to prevent decomposition of the superconductor. We have developed a low-oxygen-pressure technique for calcining precursors and sintering long lengths of wires and coils. Other advances include the improvement of critical current density and levitation force through melt-growth processing, incorporating of insulating coatings, and powder-in-tube processing of superconductors. DOE

N92-14292# Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Investigaciones.
BULK AND INTERFACE DIELECTRIC FUNCTIONS: NEW RESULTS WITHIN THE TIGHT-BINDING APPROXIMATION
V. D. Elvira and J. C. Duran 1991 13 p
(DE91-641606; INIS-mf-12940) Avail: NTIS HC/MF A03

A tight-binding approach is used to analyze the dielectric behavior of bulk semiconductors and semiconductor interfaces. This time, interactions between second nearest neighbors are taken into account and several electrostatic models are proposed for the induced charge density around the atoms. The bulk dielectric function of different semiconductors (Si, Ge, GaAs and AlAs) are obtained and compared with other theoretical and experimental results. Finally, the energy band offset for GaAs-AlAs(1,0,0) interface is obtained and related to bulk properties of both semiconductors. The results presented in this paper show how the use of very simple but more realistic electrostatic models improves the analysis of the screening properties in semiconductors, giving a new support to the consistent tight-binding method for studying characteristics related to those properties. DOE

N92-14293# Sandia National Labs., Albuquerque, NM.
THE ENVIRONMENTALLY SAFE BATTERY
S. C. Levy and N. E. Brown 1991 7 p Presented at the 3rd International Seminar on Battery Waste Management, Deerfield Beach, FL, 4-6 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-001715; SAND-91-2013C; CONF-9111108-1) Avail: NTIS HC/MF A02

There are three aspects to an environmentally safe battery. The first deals with the manufacturing process, the second with the use of environmentally friendly materials, and the third with the disposal and/or recycling of spent units. In this paper, several ongoing programs at Sandia National Laboratories that relate to the environmentally conscious manufacturing of batteries, are discussed. The solvent substitution/elimination program is a two-pronged effort, aimed at identifying new solvents which are compatible with the environment, while at the same time developing dry process cleaning technology. The joining program is evaluating new solvents for flux removal as well as the development of fluxless soldering processes. In the area of welding, new cleaning processes are under study. Chemical microsensors are under development that are capable of identifying and quantifying single chemical species. These sensors have been used to monitor and improve processes using toxic/hazardous solvents. DOE

N92-14294*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTI-MEGAWATT INVERTER/CONVERTER TECHNOLOGY FOR SPACE POWER APPLICATIONS
Ira T. Myers, Eric D. Baumann, Robert Kraus, and Ahmad N. Hammoud (Sverdrup Technology, Inc., Brook Park, OH.) 1992 11 p Proposed for presentation at the Ninth Symposium on Space Nuclear Power Systems, Albuquerque, NM, 12-16 Jan. 1992; sponsored by the Institute for Space Nuclear Power Studies
(Contract NAS3-25266)
(NASA-TM-105307; E-6543; NAS 1.15:105307) Avail: NTIS HC/MF A03 CSCL 10B

Large power conditioning mass reductions will be required to enable megawatt power systems envisioned by the Strategic Defense Initiative, the Air Force, and NASA. Phase 1 of a proposed two phase interagency program has been completed to develop an 0.1 kg/kW DC/DC converter technology base for these future space applications. Three contractors, Hughes, General Electric (GE), and Maxwell were Phase 1 contractors in a competitive program to develop a megawatt lightweight DC/DC converter. Researchers at NASA Lewis Research Center and the University of Wisconsin also investigated technology in topology and control. All three contractors, as well as the University of Wisconsin, concluded at the end of the Phase 1 study, which included some critical laboratory work, that 0.1-kg/kW megawatt DC/DC converters can be built. This is an order of magnitude lower specific weight than is presently available. A brief description of each of the concepts used to meet the ambitious goals of this program are presented. Author

N92-14295*# Auburn Univ., AL. Center for the Commercial Development of Space Power.
SILICON DEVICE PERFORMANCE MEASUREMENTS TO SUPPORT TEMPERATURE RANGE ENHANCEMENT
Semiannual Report, 7 May - 9 Nov. 1991
R. Wayne Johnson, Ray Askew, James Bromstead, and Bennett Weir 2 Dec. 1991 36 p
(Contract NCC3-175)
(NASA-CR-189522; NAS 1.26:189522) Avail: NTIS HC/MF A03 CSCL 09A

The results of the NPN bipolar transistor (BJT) (2N6023) breakdown voltage measurements were analyzed. Switching measurements were made on the NPN BJT, the insulated gate bipolar transistor (IGBT) (TA9796) and the N-channel metal oxide semiconductor field effect transistor (MOSFET) (RFH75N05E). Efforts were also made to build a H-bridge inverter. Also discussed are the plans that have been made to do life testing on the devices, to build an inductive switching test circuit and to build a dc/dc switched mode converter. Author

N92-14296# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
MEASUREMENTS AT THE COIL B604 [METINGEN AAN SPOEL B604]
J. D. Schipper and P. J. M. deGroen 1991 59 p In DUTCH
(DIGEL-1991-4; ETN-92-90304) Avail: NTIS HC/MF A04

Different measuring system were use to examine the performance of the coil B604. The first set up contains a Krohn-Hite model 3202 filter and a LeCroy 9410 digital scoop (with fast Fourier transform and calculation package) to determine the absolute values of the signals and the background signals. The filter was replaced by the instruments, for comparison. Afterwards the coil B604 was replaced by a calibrated Pearson model 301, for comparison and correction of the B604 measurements. ESA

N92-13972*# Scientific Research Associates, Inc., Glastonbury, CT.
OPTIMIZATION OF TRANSISTOR DESIGN INCLUDING LARGE SIGNAL DEVICE/CIRCUIT INTERACTIONS AT EXTREMELY HIGH FREQUENCIES (20-100+GHz)
Ralph Levy and H. L. Grubin *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 573-591 Sponsored in part by DARPA and NSF (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 09A

N92-14023# Canadian Marconi Co., Montreal (Quebec).
TESTING OF CMA-2000 MICROWAVE LANDING SYSTEM (MLS) AIRBORNE RECEIVER
L. Labreche and A. J. Murfin *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 57-59 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

N92-14238*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A RECEIVER DESIGN FOR THE SUPERCONDUCTING CAVITY-MASER OSCILLATOR
R. T. Wang and G. J. Dick *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 1-11 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09A

N92-14775*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CUSTOM MICROCIRCUITS
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 83-87 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-14297# State Univ. of New York, Stony Brook. Dept. of Mechanical Engineering.
RATIONAL APPROXIMATIONS TO FLUID PROPERTIES
J. M. Kincaid May 1990 31 p
(Contract DE-FG02-87ER-13648)
(DE90-012531; DOE/ER-13648/12) Avail: NTIS HC/MF A03

The purpose of this report is to summarize some results that were presented at the Spring AIChE meeting in Orlando, Florida

(20 March 1990). We report on recent attempts to develop a systematic method, based on the technique of rational approximation, for creating mathematical models of real-fluid equations of state and related properties. Equation-of-state models for real fluids are usually created by selecting a function tilde p(T,rho) that contains a set of parameters (gamma sub i); the (gamma sub i) is chosen such that tilde p(T,rho) provides a good fit to the experimental data. (Here p is the pressure, T the temperature and rho is the density). In most cases, a nonlinear least-squares numerical method is used to determine (gamma sub i). There are several drawbacks to this method: one has essentially to guess what tilde p(T,rho) should be; the critical region is seldom fit very well and nonlinear numerical methods are time consuming and sometimes not very stable. The rational approximation approach we describe may eliminate all of these drawbacks. In particular, it lets the data choose the function tilde p(T,rho) and its numerical implementation involves only linear algorithms.

DOE

N92-14298 State Univ. of New York, Buffalo.
REYNOLDS STRESS MODEL PREDICTIONS OF SUPERSONIC TURBULENT BOUNDARY LAYER FLOW OVER COMPRESSION SURFACES Ph.D. Thesis
Jinho Lee 1991 245 p
Avail: Univ. Microfilms Order No. DA9121042

A framework for predicting complex 2-D turbulence compressible flows is presented. The compressible turbulence closure problem is defined and discussed. Implementation, validation, and comparison of numerical techniques used to solve the mass (Favre) averaged Navier-Stokes equations are also presented along with the curved surface predictions. A theoretical study was conducted to determine the effects of adverse pressure gradients and compressibility in modeling turbulent compressible flows. The turbulent kinetic energy/dissipation and Reynolds stress model predictions of turbulent supersonic boundary layers are compared with experimental data and the predictions of zero equation model mass averaged Navier-Stokes computations. A new compressible formulation of the pressure strain term, which includes the dilation effects, in the Reynolds stress equation, is presented. The predictions for curved compression ramps using the new pressure strain model and other compressibility terms exhibited improvements over the standard model predictions without these terms. Dissert. Abstr.

N92-14299 Cornell Univ., Ithaca, NY.
TURBULENCE MEASUREMENTS IN AXISYMMETRIC JETS OF AIR AND HELIUM Ph.D. Thesis
N. R. Panchapakesan 1991 110 p
Avail: Univ. Microfilms Order No. DA9113293

Turbulent axisymmetric jets of air helium with the same nozzle momentum flux were studied experimentally using hot-wire probes. An X-wire hot-wire probe was used in the air jet and a composite probe consisting of an X-wire and an interference probe of the Way-Libby type was used in the helium jet to measure the helium concentration and two velocity components. Moments of turbulent fluctuations, up to fourth order, were calculated to characterize turbulent transport in the jet and to evaluate current models for triple moments that occur in the Reynolds stress equation. In the air jet, the momentum flux across the jet was found to be within +/- 5 percent of the nozzle input and the integral of the radial diffusive flux of the turbulent kinetic energy across the jet was found to be close to zero indicating consistency of measurements with the equations of motion. The fourth moments were very well described in terms of the second moments by the quasi-Gaussian approximation across the entire jet. Profiles of third moments were found to be significantly different from earlier measurements - (u(v exp 2)) (u(w exp 2)) and ((u exp 2)v) were found to be negative near the axis of the jet. The measurements in the helium jet were in the intermediate region between the non-buoyant jet and the plume regions. The helium mass flux across the jet was found to be within +/- 0 percent of the nozzle input. The far field behavior was in accord with the expected plume scalings. The near field behavior of the mean velocity along the axis of the jet follows the scaling expressed by the effective diameter but the mean concentration decay has a different density ratio dependence. The radical profiles of mean velocity and concentration indicate a turbulent Schmidt number of 0.7, the same as for passive scalars in round jets. Turbulent intensity of axial velocity fluctuations was significantly higher than that observed in the air jet while the radial and azimuthal intensities are virtually identical with the air jet when scaled with the half-widths. Two models for triple moments were evaluated with measurements in both air and helium jets.

Dissert. Abstr.

N92-14300# National Academy of Sciences - National Research Council, Washington, DC.
EIGHTEENTH SYMPOSIUM ON NAVAL HYDRODYNAMICS
National Academy Press 1991 805 p Symposium held in Ann Arbor, MI, 19-24 Aug. 1990
(Contract N00014-87-C-0018; ONR Proj. 201-124)
(LC-91-62359; ISBN-0-309-04575-4) Avail: NTIS HC/MF A99

The proceedings are presented of the conference on Naval Hydrodynamics. Papers were presented in seven topical areas: ship motions; ship hydrodynamics; experimental techniques; free surface aspects; wave/wake dynamics; propeller hull appendage interactions; and viscous effects. Examples or advances made in these areas are in the solution of nonlinear equations for ship motions and ship hydrodynamics, the small scale dynamics of cavitation inception, development and implementation of multipoint, free surface measurements, modeling of solitons in Kelvin wakes, reconnection phenomena for vortex interactions with the free surface, Navier-Stokes solutions for propellers, and the inclusion of the hull boundary layer in prediction of hull flows. For individual titles, see N92-14301 through N92-14312.

N92-14301# Laboratoire d'Hydrodynamique Navale (France).
A COUPLED TIME AND FREQUENCY APPROACH FOR NONLINEAR WAVE RADIATION
P. Ferrant (Sirehna S.A., Nantes, France) *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 67-83 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

Computations are reported which use a semi nonlinear time domain formulation for the 3-D wave radiation problem with a free surface. The body boundary condition is applied at the actual time depending body surface, and the free surface conditions are linearized. An initial value problem is solved for the potential on the moving body, using a boundary element method. The method allows the hydrodynamic forces on bodies of arbitrary geometry undergoing large amplitude forced motions in six degrees of freedom to be determined, as well as the unsteady wave field generated by the body motions. Two different applications are presented. The first refers to the problem of a sphere undergoing large amplitude periodic motions below the free surface. A thorough parametrical study was completed in this case, and the influence of the body nonlinearity is clearly highlighted both on the hydrodynamic forces and on the structure of the radiated wave field, which is studied using specific frequency domain Green functions associated to the body nonlinear problem. Some results on a submerged spheroid starting from rest with a constant velocity parallel to the free surface are also presented, as an unsteady approach to the wave resistance problem. Author

N92-14302# China Ship Scientific Research Center, Wuxi.
A NUMERICAL RESEARCH OF NONLINEAR BODY-WAVE INTERACTIONS
Zhenquan Zhou and Maoxiang Gu *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 103-118 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

Numerical research results are presented of nonlinear body wave interactions. The body wave interaction is treated as a transient problem with known initial conditions. The development of the flow can be obtained by a time stepping procedure, in which the velocity potential of the flow at any instant is obtained by using a source density distribution on all boundary surfaces.

The Orlanski's method is used to implement the boundary conditions at the open boundary. The position of intersection points are determined by a direct method. A study was made of the nonlinear radiation problem of a floating body. A study was also made of nonlinear wave diffraction problem around large structures. Interaction of nonlinear waves with a free floating body was also studied, along with an attempt in generating a numerical wave tank. Pretty good agreement was found between the numerical results and the analytical solution. Author

N92-14303# Newcastle-upon-Tyne Univ. (England).
EFFECT OF VISCOUS DAMPING ON THE RESPONSE OF FLOATING BODIES
M. Downie, J. Graham (Imperial Coll. of Science and Technology, London, England), and X. Zheng *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 149-156 Sponsored by Science Research Council (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

The prediction of hydrodynamic damping due to vortex shedding on a three dimensional body in waves is discussed. A method of matching precalculated results for separated oscillatory flow past an isolated edge at each vortex shedding region of the outer potential flow field of the body in waves was extended to 3-D floating bodies by two different methods. In the first method the pressure field due to a local separated flow computed by a discrete vortex method is applied at all vortex shedding edges of the hull. In the second method, the effect of vortex shedding at an edge is represented directly in the frequency domain panel method by special edge panels. A dipole density on each of these edge panels is evaluated by making a comparison between the far field effect of the panel and the far field of the appropriate separated vortex flow modelled by the vortex method. Author

N92-14304# Istituto Nazionale di Studi Espe Architettura Navale, Rome (Italy).
A BOUNDARY INTEGRAL APPROACH IN PRIMITIVE VARIABLES FOR FREE SURFACE FLOWS
C. Casciola and R. Piva (Rome Univ., Italy) *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 221-237 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

The boundary integral formulation, very efficient for free surface potential flows, was considered for its possible extension to rotational flows either inviscid or viscous. We first analyze a general formulation for unsteady Navier-Stokes equations in primitive variables, which reduces to a representation for the Euler equations in the limiting case of Reynolds infinity. A first simplified model for rotational flows, obtained by decoupling kinematics and dynamics, reduces the integral equations to a known kinematical form whose mathematical and numerical properties have been studied. The dynamics equations to complete the model are obtained for the free surface and the wake. A simple and efficient scheme for the study of the non linear evolution of the wave system and its interaction with the body wake is presented. A steady state version for the calculation of the wave resistance is also reported. A second model was proposed for the simulation of rotational separated regions, by coupling the integral equations in velocity with an integral equation for the vorticity at the body boundary. The same procedure may be extended to include the diffusion of the vorticity in the flowfield. The vortex shedding from a cylindrical body in unsteady motion is discussed, as a first application of the model. Author

N92-14305# Michigan Univ., Ann Arbor.
TURBULENCE MEASUREMENTS IN A SUBMERGED JET NEAR A FREE SURFACE
D. Anthony, W. Willmarth, K. Madnia, and L. Bernal *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 361-372 (For primary document see N92-14300 05-34)
(Contracts N00184-86-K-0684; N00014-90-WX-22034)
Avail: NTIS HC/MF A99

The results of two experimental investigations on the flow structure of a circular jet issuing beneath a free surface are presented. The mean flow scaling was determined from velocity measurements made with a hotfilm anemometer. The free surface is shown to decrease the decay rate of the maximum velocity in comparison to a free jet. The similarity scaling of the flow is discussed based on a simple model. The mean flow and all components of the Reynolds stress tensor were measured with a three-component laser Doppler velocimeter (LDV) system. Measurements beneath a clean free surface show that the mean flow spreads laterally in a shallow surface current, and the turbulent velocity fluctuations become anisotropic as the surface is approached. Flow visualization reveals that the surface current contains fluid structures ejected from the jet, and the current is suppressed with the addition of surface active agents. Author

N92-14306# Michigan Univ., Ann Arbor.
THREE-DIMENSIONAL, UNSTEADY COMPUTATIONS OF NONLINEAR WAVES CAUSED BY UNDERWATER DISTURBANCES
Yusong Cao, W. Schultz, and R. Beck *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 417-425 (For primary document see N92-14300 05-34)
(Contract N00184-86-K-0684)
Avail: NTIS HC/MF A99

Three dimensional unsteady nonlinear waves generated by underwater disturbances (such as a moving source sink pair or a moving body) are modeled using a mixed Eulerian-Lagrangian time marching procedure combined with a desingularized boundary integral method. The waves computed by the present method are compared with those for linear theory to find the nonlinear effects. The wave resistance, lift, moment, and the pressure distributions on the body are also calculated. We find that the wave patterns of a spheroid and a relevant simple source sink pair disturbance are very similar as long as the disturbances are not too close to the free surface. Author

N92-14307# Korea Research Inst. of Ships and Ocean Engineering, Daejeon (Republic of Korea).
A NUMERICAL SOLUTION METHOD FOR THREE-DIMENSIONAL NONLINEAR FREE SURFACE PROBLEMS
Chang-Gu Kang and I.-Y. Gong *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 427-438 Sponsored in part by Ministry of Science and Technology of Korea (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

The nonlinear hydrodynamics of a three dimensional body beneath the free surface are solved in the time domain by a semi Lagrangian method. The boundary value problem is solved by using the boundary integral method. The geometries of the body and the free surface are represented by the curved panels. The surfaces are discretized into the small surface elements using a bi-cubic B-spline algorithm. The boundary values of phi and partial derivative of phi with respect to partial derivative of n are assumed to be bilinear on the subdivided surface. The singular part proportional to 1/R is subtracted off and is integrated analytically in the calculation of the induced potential by singularities. The far field flow away from the body is represented by a dipole at the origin of the coordinate system. The Runge-Kutta 4th order algorithm is employed in the time stepping scheme. The three dimensional form of the integral equation and the boundary conditions for the time derivative of the potential is derived. By using these formulas, the free surface shape and the forces acting on a body oscillating sinusoidally with large amplitude are calculated and compared with published results. Nonlinear effects on a body near the free surface are investigated. Author

N92-14308# Michigan Univ., Ann Arbor.
VORTEX RING INTERACTION WITH A FREE SURFACE
M. Song, N. Kachman, J. Kwon, L. Bernal, and G. Tryggvason *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 479-489 (For primary document see N92-14300

05-34)
(Contract N00184-86-K-0684)
Avail: NTIS HC/MF A99

The results of numerical and experimental studies on the interaction of vortex rings with a free surface are presented. New results are reported on the interaction of a large vortex ring with a clean surface at normal incidence. The early stages of the interaction are well described by a simple axisymmetric vortex filament model. Transition to a fully three-dimensional state is observed at later stages of the interaction. Surface waves are generated at high Froude numbers by these three-dimensional motions. Results are also presented on the interaction of vortex rings with clean and contaminated free surfaces at included incidence. The phenomenon of vortex lines breaking and attachment to the free surface is documented. It is shown that small amounts of surface active agents greatly alter the interaction at inclined incidence. The effect differs, depending on the local topology of the vortex lines. A Reynolds ridge and secondary vorticity generation are observed during the interaction with a contaminated surface. Author

N92-14309# David Taylor Research Center, Bethesda, MD.
NAVIER-STOKES ANALYSIS OF TURBULENT BOUNDARY LAYER AND WAKE FOR TWO-DIMENSIONAL LIFTING BODIES
Phuc Nguyen and J. Gorski *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 633-644 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99

Navier-Stokes calculations were performed on two 2-D lifting foils which have been tested in a wind tunnel. In the experiment, the angles of attack for the two foils were set up to yield approximately the same lift at a Reynolds number of 2.25x10(exp 6) (based on chord). One foil has a thicker trailing edge than the other, and has mild flow separation on the last 4 percent chord of the suction side. The flow solver, called the David Taylor Navier-Stokes (DTNS) code, is formulated with artificial compressibility and upwind differencing. The Launder-Spalding kappa-epsilon turbulence model is used. Predictions of the turbulent flow quantities of the boundary layer and wake are compared with the experimental data for both foils. These predictions, including flow separation location, agree reasonably well with the data. After these validation predictions, the Navier-Stokes analysis method and a design technique based on conformal mapping are combined to develop new 2-D foil sections. Since the turbulent kinetic energy is the dynamic pressure, and the Reynolds shear stresses are related to the turbulence production, these quantities are used to develop new 2-D sections with desirable turbulent boundary layer characteristics. The characteristics of one new section are presented as results of the new foil design process. Author

N92-14310*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A NAVIER-STOKES SOLUTION OF HULL-RING WING-THRUSTER INTERACTION
C.-I. Yang (David Taylor Research Center, Bethesda, MD.), P. Hartwich, and P. Sundaram *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 687-696 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99 CSCL 20D

Navier-Stokes simulations of high Reynolds number flow around an axisymmetric body supported in a water tunnel were made. The numerical method is based on a finite-differencing high resolution second-order accurate implicit upwind scheme. Four different configurations were investigated, these are: (1) barebody; (2) body with an operating propeller; (3) body with a ring wing; and (4) body with a ring wing and an operating propeller. Pressure and velocity components near the stern region were obtained computationally and are shown to compare favorably with the experimental data. The method correctly predicts the existence and extent of stern flow separation for the barebody and the absence of flow separation for the three other configurations with ring wing and/or propeller. Author

N92-14311# Science Applications International Corp., La Jolla, CA.
A NUMERICAL STUDY OF THREE-DIMENSIONAL VISCOUS INTERACTIONS OF VORTICES WITH A FREE SURFACE
D. Dommermuth and D. Yue (Massachusetts Inst. of Tech., Cambridge.) *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 727-788 (For primary document see N92-14300 05-34)
Avail: NTIS HC/MF A99 CSCL 20D

Semi-implicit and explicit numerical methods are developed for the direct simulation of the three-dimensional Navier-Stokes equations with a free surface. The efficiency of a novel multigrid flow solver permits the simulation of three-dimensional flows with free surfaces at low Reynolds and Froude numbers. The numerical schemes are used to study vortex rings and tubes interacting with walls and free surfaces. In the case of vortex rings interacting with a no-slip wall observations of the formation of secondary and tertiary vortex rings agree qualitatively with experimental measurements. When a free surface is present, the results are sensitive to the Froude number. For sufficiently low Froude numbers, the free surface behaves like a free-slip wall, which agrees qualitatively with experimental observations of vortex rings interacting with clean free surfaces. At intermediate Froude numbers, the normal incidence of a vortex ring with a clean free surface results in the formation of secondary vortex rings. Numerical studies of vortex tubes interacting with free surfaces show two possible mechanisms for the reconnection of vorticity with a free surface including primary and secondary vorticity reconnections. One type of primary vorticity reconnection should result in a cusp pattern on the free surface and secondary vorticity reconnections should manifest themselves as paired dimples on the free surface. The essential stages of the reconnection of secondary vorticity with the free surface are as follows: generation of helical vortex sheets by the primary vortex tube, stripping of the helical vortex sheets due to self-induced straining flows, attachment of the helical vortex sheets to the separated free-surface boundary layer, wrapping of U-shaped vortices around the primary vortex tube, feeding of boundary-layer vorticity into the U-vortices, and reconnection of U-vortices with the free surface. We provide evidence which suggests that the striations that may be observed on the free-surface above a pair of trailing tip vortices are caused by helical vorticity. Author

N92-14312# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE FLOW PAST WING-BODY JUNCTION: AN EXPERIMENTAL EVALUATION OF TURBULENCE MODELS
W. J. Devenport and R. L. Simpson *In* NAS-NRC, Eighteenth Symposium on Naval Hydrodynamics 1991 p 815-828 (For primary document see N92-14300 05-34)
(Contract N00014-87-K-0421)
Avail: NTIS HC/MF A99

N92-14313*# Nevada Univ., Reno. Engineering Research and Development Center.
NUMERICAL INVESTIGATIONS IN THREE-DIMENSIONAL INTERNAL FLOWS Semiannual Status Report, 1 Jul. - 31 Dec. 1991
William C. Rose 1991 27 p
(Contract NCC2-507)
(NASA-CR-189467; NAS 1.26:189467) Avail: NTIS HC/MF A03 CSCL 20D

The general objectives of NASA's Generic Hypersonics Research Program (GHP) are to develop a technology background required for aeronautical research in the hypersonic Mach number flow range. These research efforts are to complement the National Aerospace Plane (NASP) Program and are geared toward the development of experimental and computational fluid dynamics (CFD) techniques. One of the prominent goals of inlet design for high speed applications is to produce an inlet that delivers uniform

flow at its exit in the shortest possible distance. In previous studies, the technologies for determining contours for both the ramp and cowl were demonstrated that allowed a nearly shock free exiting flow field to be obtained. This technology was developed further during the present reporting period and applied to a preliminary design investigation of a biconic hypersonic research vehicle with a nearly 2-D inlet attached near the aft end of the vehicle. The results of a parametric investigation of this proposed inlet for freestream Mach numbers between 10 and 15 are described.
Author

N92-14314*# Eloret Corp., Sunnyvale, CA.
AN EXPERIMENTAL INVESTIGATION OF THE SEPARATING/REATTACHING FLOW OVER A BACKSTEP
Progress Report, 1 Jan. - 31 Aug. 1991
Srboljub Jovic 10 Dec. 1991 26 p
(Contract NCC2-465)
(NASA-CR-189495; NAS 1.26:189495) Avail: NTIS HC/MF A03 CSCL 20D

Reynolds number effects on the evolution of the turbulence structure in the recovery region of a turbulent separated flow generated by a backward-facing step were studied experimentally. Five different flow conditions and four Reynolds numbers were investigated. All single point measurements were conducted on the plane of symmetry of the wind tunnel starting at approximately $x/h = 10$ for each flow condition. The upper limit of the measuring domain depends upon the physical size of the tunnel and ranged from 50 to 114 step heights. It is apparent that most of the boundary layer recovery was captured by the experiment. Normal stresses, shear stress, mixing length scales and eddy viscosity are shown, while the higher order velocity products related to the diffusion of the turbulence energy are planned for latter stages of the data analysis.
Author

N92-14315# Michigan Univ., Ann Arbor.
DROP/GAS INTERACTIONS IN DENSE SPRAYS Annual Technical Report, Aug. 1990 - Aug. 1991
G. M. Faeth 15 Aug. 1991 7 p
(Grant AF-AFOSR-0516-89; AF Proj. 2308)
(AD-A241564; AFOSR-91-0764TR) Avail: NTIS HC/MF A02 CSCL 20/4

Two processes of dense sprays are being studied: (1) turbulence modulation, which involves the turbulent field generated by drop motion; and (2) secondary drop breakup which can be the rate controlling process in dense sprays. Since past work on turbulence modulation highlighted the need for information on drop wake properties for low drop Reynolds numbers (10-1000), measurements of these flows are in progress using spheres traversing in stagnant glycerol baths. Three wake regions have been identified: a fast-decaying wake (caused by eddy shedding at drop Reynolds numbers greater than 200), a turbulent wake (extending to wake Reynolds numbers of 5-8), and a final laminar wake. Turbulence is not highly developed in the turbulent wakes, yet mean velocities satisfy similarity theory quite well. Current work is concentrating on results at higher Reynolds numbers, to approach results in the literature; studying wakes in turbulent environments; and introducing these results into a stochastic theory of turbulence modulation. Secondary drop breakup is being studied in a shock tube using water, glycerol and n-heptane drops. A breakup regime map has been developed, defining no-deformation, oscillatory deformation, non-oscillatory deformation, bag breakup, multimode breakup, and shear breakup regimes as a function of Weber and Ohnesorge numbers. Results at Ohnesorge numbers greater than 4 show that these conditions are dominated by the no-deformation regime. Current work involves measurements of the dynamics and outcomes of bag and multimode breakup.
GRA

N92-14316# California Univ., Berkeley. Lawrence Berkeley Lab.
TOUGH2: A GENERAL-PURPOSE NUMERICAL SIMULATOR FOR MULTIPHASE FLUID AND HEAT FLOW
K. Pruess May 1991 102 p
(Contract DE-AC03-76SF-00098)
(DE92-000755; LBL-29400) Avail: NTIS HC/MF A06

TOUGH2 is a numerical simulation program for nonisothermal flows of multicomponent, multiphase fluids in porous and fractured media. The chief applications for which TOUGH2 is designed are in geothermal reservoir engineering, nuclear waste disposal, and unsaturated zone hydrology. A successor to the TOUGH program, TOUGH2 offers added capabilities and user features, including the flexibility to handle different fluid mixtures, facilities for processing of geometric data (computational grids), and an internal version control system to ensure referenceability of code applications. This report includes a detailed description of governing equations, program architecture, and user features. Enhancements in data inputs relative to TOUGH are described, and a number of sample problems are given to illustrate code applications.
DOE

N92-14317# California Univ., San Diego, La Jolla. Inst. for Nonlinear Science.
PARAMETERIZATION OF INTERMITTANT TURBULENCE AND THE VORTON METHOD
E. Novikov 1991 8 p
(Contract DE-FG03-87ER-13801)
(DE92-000758; DOE/ER-13801/T1) Avail: NTIS HC/MF A02

The main mechanism of three-dimensional turbulent flow is the stretching of vortex filaments and self-amplification of vorticity field. Stretching eventually leads to vortex reconnections and strong dissipation of energy in the areas of reconnections; which are manifestations of intermittency. An example of vortex breakdown and reconnection is the shedding of vortex rings from the horseshoe-like vortices in a boundary layer. Another example is the transformation of vortex ring into horseshoe vortex during the oblique interaction with a boundary in shear flow. Vortex events of this kind probably make a significant contribution to momentum and heat transport in turbulent boundary layers. Analogous events in the atmospheric boundary layer cause aircraft accidents. Vortex reconnections occur also in a free flow far from the boundary, for example, an elliptic vortex ring splits into two deformed vortex rings. Another example is Grow instability of two perturbed antiparallel vortex filaments. An example of successive vortex reconnections is merging and subsequent splitting of vortex rings. Generally, successive vortex reconnections can be considered as a manifestation of the energy transport from large scale to small scale motions in three-dimensional turbulent flows and can be used in statistical description of turbulence.
DOE

N92-14318# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
HEAT PUMPS FOR INDUSTRY
Sep. 1991 23 p
(Contract DE-AC02-83CH-10093)
(DE91-015030; DOE/CH-10093/114) Avail: NTIS HC/MF A03

Research activities, both in the laboratory and in the field, confirm that heat pumps can improve energy efficiency and productivity for a multitude of process types. By using heat pumps, process industries can save significant amounts of energy and money and successfully control emissions. Those industries with special needs, such as recovering solvents, can meet them more energy efficiently and cost effectively with heat pumps. Through the years, the Office of Industrial Technologies (OIT) has helped industry solve its energy problems by joining in cooperative agreements with companies willing to do the research. The companies involved in these agreements share the costs of the research and benefit directly from the technology developed. OIT then has information from demonstration projects that it can pass on to others within industry. All the projects described in this brochure were joint ventures between DOE and industry participants. OIT will assist in accelerating the use of heat pumps in the industrial marketplace by continuing to work with industry on research and demonstration projects and to transfer research results and project performance information to the rest of industry. Successfully transferring this technology could conserve as much

as 1.5 quads of energy annually at a savings of more than $4 billion at today's prices. DOE

N92-14319# Royal Aerospace Establishment, Farnborough (England).
PREDICTIONS AND MEASUREMENTS OF 3D VISCOUS FLOW IN A TRANSONIC TURBINE NOZZLE GUIDE VANE ROW
G. C. Horton, S. P. Harasgama, and K. S. Chana 25 Apr. 1991 19 p Presented at the 77th AGARD PEP Symposium, San Antonio, TX, May 1991
(RAE-TM-P-1205; BR303627; ETN-92-90700) Copyright Avail: NTIS HC/MF A03

A transonic turbine nozzle guide vane was tested in an annular cascade with two different endwall geometries. The measurements were taken at engine representative flow conditions and include surface static pressures and a down stream area traverse of total pressure. The flow through these geometries was modeled at the test conditions using a three dimensional viscous flow program. The effects of different mesh densities and two turbulence models were studied. Predictions of secondary flow and loss were obtained and are compared with the experimental measurements. The different turbulence models were found to have little effect in the predicted overall loss though there were differences in the distribution and the shape of the vane wakes. The one equation turbulence model produced wakes which had similar levels of total pressure deficit to the experiment and had a more similar shape than those with the Baldwin-Lomax algebraic model. ESA

N92-14320*# Southwest Research Inst., San Antonio, TX. Mechanical and Fluids Engineering Div.
FLUID MANAGEMENT TECHNOLOGY: LIQUID SLOSH DYNAMICS AND CONTROL Interim Report, 1 Oct. 1988 - 1 Jul. 1991
Franklin T. Dodge, Steven T. Green, and Daniel D. Kana 1 Nov. 1991 185 p
(Contract NAS3-25358; SwRI Proj. 04-2453)
(NASA-CR-189107; NAS 1.26:189107) Avail: NTIS HC/MF A09 CSCL 20D

Flight experiments were defined for the Cryogenic On-Orbit Liquid Depot Storage, Acquisition and Transfer Satellite (COLD-SAT) test bed satellite and the Shuttle middeck to help establish the influence of the gravitational environment on liquid slosh dynamics and control. Several analytical and experimental studies were also conducted to support the experiments and to help understand the anticipated results. Both FLOW-3D and NASA-VOF3D computer codes were utilized to simulate low Bond number, small amplitude sloshing, for which the motions are dominated by surface forces; it was found that neither code provided a satisfactory simulation. Thus, a new analysis of low Bond number sloshing was formulated, using an integral minimization technique that will allow the assumptions made about surface physics phenomena to be modified easily when better knowledge becomes available from flight experiments. Several examples were computed by the innovative use of a finite-element structural code. An existing spherical-pendulum analogy of nonlinear, rotary sloshing was also modified for easier use and extended to low-gravity conditions. Laboratory experiments were conducted to determine the requirements for liquid-vapor interface sensors as a method of resolving liquid surface motions in flight experiments. The feasibility of measuring the small slosh forces anticipated in flight experiments was also investigated. Author

N92-14321# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
A MULTIGRID METHOD FOR AN INVARIANT FORMULATION OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS IN GENERAL COORDINATES
C. W. Oosterlee and P. Wesseling 1991 29 p
(Rept-91-12; ISSN-0922-5641; ETN-92-90392) Copyright Avail: NTIS HC/MF A03

Results for the two dimensional case with Dirichlet boundary conditions are presented. The equations are presented in a tensor formulation and some basic tools of tensor analysis are given together with insights into choices for computing geometric quantities and the choice of variables. A nonlinear multigrid algorithm in the structured goto-free version, the prolongation and restriction operator, and the smoother and the choice for the coarse grid operator are given. A comparison between reduction factors for a rectangular and a skewed driven capacity flow is given. The flow through an L shaped pipe with a low Reynolds number is presented and the flow though a nozzle is computed to show the accuracy of the discretization in the presence of appreciable grid irregularity. ESA

N92-14322*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STABLE LOCALIZED PATTERNS IN THIN LIQUID FILMS
Robert J. Deissler and Alexander Oron (Technion - Israel Inst. of Tech., Haifa.) Nov. 1991 14 p
(NASA Order C-99066-G)
(NASA-TM-105352; ICOMP-91-26; E-6726; NAS 1.15:105352)
Avail: NTIS HC/MF A03 CSCL 20D

We study a 2-D nonlinear evolution equation which describes the 3-D spatiotemporal behavior of the air-liquid interface of a thin liquid film lying on the underside of a cooled horizontal plate. We show that the Marangoni effect can stabilize the destabilizing effect of gravity (the Rayleigh-Taylor instability) allowing for the existence of stable localized axisymmetric solutions for a wide range of parameter values. Various properties of these structures are discussed. Author

N92-14323*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELF-PRESSURIZATION OF A SPHERICAL LIQUID HYDROGEN STORAGE TANK IN A MICROGRAVITY ENVIRONMENT
C. S. Lin (Analex Corp., Brook Park, OH.) and M. M. Hasan 1992 11 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(NASA-TM-105372; E-6759; NAS 1.15:105372; AIAA-92-0363)
Avail: NTIS HC/MF A03 CSCL 20D

Thermal stratification and self-pressurization of partially filled liquid hydrogen (LH2) storage tanks under microgravity condition is studied theoretically. A spherical tank is subjected to a uniform and constant wall heat flux. It is assumed that a vapor bubble is located in the tank center such that the liquid-vapor interface and tank wall form two concentric spheres. This vapor bubble represents an idealized configuration of a wetting fluid in microgravity conditions. Dimensionless mass and energy conservation equations for both vapor and liquid regions are numerically solved. Coordinate transformation is used to capture the interface location which changes due to liquid thermal expansion, vapor compression, and mass transfer at liquid-vapor interface. The effects of tank size, liquid fill level, and wall heat flux on the pressure rise and thermal stratification are studied. Liquid thermal expansion tends to cause vapor condensation and wall heat flux tends to cause liquid evaporation at the interface. The combined effects determine the direction of mass transfer at the interface. Liquid superheat increases with increasing wall heat flux and liquid fill level and approaches an asymptotic value. Author

N92-14324# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON A DOUBLY DEGENERATE EQUATION ARISING IN FRESH-SALT WATER FLOW WITH PUMPING
Philippe Blanc and Shuanhu Li 1991 30 p Sponsored in part by Swiss National Science Foundation
(Rept-91-30; ISSN-0922-5641; ETN-92-90409) Copyright Avail: NTIS HC/MF A03

A Cauchy problem is studied. The physical background of the problem, where a horizontally homogenous aquifer of constant thickness is considered, is given. The solution is shown to satisfy a contraction property. It then follows that the problem has at most one solution. The existence result is established via

approximation. A method based on a level line argument to get a gradient bound which is crucial for the existence is used. ESA

N92-14325# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
NUMERICAL EVALUATION OF AN EFFECTIVE ROE SCHEME AND CHEMICAL MODELS FOR CHEMICALLY REACTING NOZZLE FLOWS IN THERMAL EQUILIBRIUM
S. P. Spekreijse and A. C. J. Venis Jun. 1991 61 p
(LR-623; NLR-TP-90060-L; ETN-92-90414) Avail: NTIS HC/MF A04

An efficient Roe type flux difference scheme for chemically reacting inviscid compressible flow in thermal equilibrium is presented. The numerical scheme is validated, and three well known chemical models are compared. The set of test cases concerned quasi-1-D hypersonic nozzle flows, with and without strong normal shockwaves. ESA

N92-14326# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
NUMERICAL EVALUATION OF AN EFFICIENT ROE-TYPE FLUX DIFFERENCE SCHEME FOR THERMOCHEMICAL NON-EQUILIBRIUM NOZZLE FLOWS
A. C. J. Venis and S. P. Spekreijse Jun. 1991 54 p
(LR-624; NLR-TP-90099-L; ETN-92-90415) Avail: NTIS HC/MF A04

An efficient Roe type flux difference scheme for chemically reacting, inviscid, compressible flows in thermal nonequilibrium is presented. The numerical scheme is validated. The test cases concerned quasi-1-D hypersonic nozzle flows with and without strong normal shockwaves. ESA

N92-14327# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
AN APPLICATION OF CONFORMAL MAPPINGS TO GENERAL GRID GENERATION AND POTENTIAL FLOW PROBLEMS
T. R. Bewley Nov. 1990 47 p
(VKI-TN-175; ETN-92-90456) Avail: NTIS HC/MF A03

The generation of smooth, orthogonal, body fitted grids is an important first step towards the accurate numerical solution of fluid flows using finite difference methods. To produce a suitable grid for a numerical computation, a powerful grid generation technique employing conformal mappings was developed. This technique is summarized. Once a mapping has been established for a specific geometry, using this method to directly compute two dimensional incompressible potential flow solutions is a straightforward process. This technique is also investigated. The generalized code developed in this project was employed in two research projects, indicating the viability of this method for easy adaptation to problems of interest. The first example used the transformation to solve potential flows in channels. The second used the transformation to investigate unstable flows in porous media. Extension of this code to other grid generation problems is also exemplified. The variety of these examples should illustrate how to apply the present code to problems of future interest. ESA

N92-14328# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
NUMERICAL SIMULATION OF SPATIALLY DEVELOPING FORCED AND NATURAL MIXING LAYERS WITH LARGE EDDY SIMULATION (LES)
C. Pianese and C. Benocci Apr. 1991 55 p
(VKI-TN-176; ETN-92-90457) Avail: NTIS HC/MF A04

The spatially developing planer mixing layer solving the three dimensional incompressible Navier-Stokes equations in the primitive variables u-p (velocity vector - pressure) formulation with the large eddy simulation (LES) model of turbulence is numerically simulated. Discretization in space is achieved using a finite volume technique on a staggered grid. Different discretization schemes for the convective term were compared; laminar and subgrid stresses are discretized with centered second order accurate formulae. A second order predictor corrector Adam-Bashforth method is employed to advance the solution in time. Calculations were performed for both natural and forced mixing layers and reasonable agreement found with both experimental data and numerical simulation. The influence of the data sampling technique upon the quality of the results was also evidenced. ESA

N92-14329# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MODELLING OF TURBULENT HEAT TRANSPORT: A STATE-OF-THE-ART
A. Benocci Apr. 1991 66 p
(VKI-TM-47; ETN-92-90458) Avail: NTIS HC/MF A04

An overview of the current state of single point turbulence modeling for flows including heat transfer is given. The different levels of eddy viscosity closure are covered, together with algebraic and full Reynolds stress models. Emphasis is given to the different approaches possible for the modeling of wall effects on turbulence. The specific problems related to the modeling of heat transfer are reviewed and the performances of the different models discussed on the basis of selected examples taken from the most recent literature. The conclusion is reached that the full Reynolds stress model is the only closure offering reliable results for turbulent heat transfer in complex flow problem. ESA

N92-13937*# Rensselaer Polytechnic Inst., Troy, NY. Center for Multiphase Research.
ELECTRICAL IMPEDANCE IMAGING IN TWO-PHASE, GAS-LIQUID FLOWS: 1. INITIAL INVESTIGATION
J. T. Lin, L. Ovacik, and O. C. Jones *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 111-122 Sponsored in part by Hitachi, Ltd., Ibaraki, Japan (For primary document see N92-13928 05-01)
(Contract DE-FG07-90ER-13032)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13945*# Cincinnati Univ., OH. Dept. of Mathematical Sciences.
NUMERICAL IDENTIFICATION OF BOUNDARY CONDITIONS ON NONLINEARLY RADIATING INVERSE HEAT CONDUCTION PROBLEMS
Diego A. Murio *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 227-238 Sponsored in part by a W. Taft Fellowship (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13950*# Stuttgart Univ. (Germany, F.R.). Inst. fuer Aerodynamik und Gasdynamik.
SUPERCRITICAL BLADE DESIGN ON STREAM SURFACES OF REVOLUTION WITH AN INVERSE METHOD
E. Schmidt and H.-D. Grein *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 293-305 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13957*# Columbia Univ., New York, NY. Dept. of Mechanical Engineering.
ADJOINT OPERATOR APPROACH TO SHAPE DESIGN FOR INTERNAL INCOMPRESSIBLE FLOWS
H. Cabuk, C.-H. Sung (David Taylor Research Center, Bethesda, MD.), and V. Modi *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 391-404 (For primary document see N92-13928 05-01)
(Grant NSF CBT-87-10561)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13962*# Khmelnitsky Technological Inst. (USSR).
IDENTIFICATION OF DYNAMIC CHARACTERISTICS OF FLEXIBLE ROTORS AS DYNAMIC INVERSE PROBLEM
W. P. Roisman and L. D. Vajingortin *In* Pennsylvania State

Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 457-468 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13967*# Moscow Inst. of Aviation Technology (USSR). Dept. of Space System Engineering and Design.
INVERSE PROBLEMS AND OPTIMAL EXPERIMENT DESIGN IN UNSTEADY HEAT TRANSFER PROCESSES IDENTIFICATION
Eugene A. Artyukhin *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 513-530 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20D

N92-13985# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
NONSTATIONARY GASDYNAMICS
J. J. Gottlieb, C. P. T. Groth, R. J. Hawboldt, D. F. Hawken, G. D. Lock, C. H. Wong, Y. S. Chan, J. Maillette, G. L. Petrini, and J. S. Picket et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 93-95 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-13986# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SHOCK WAVES, IMPLOSIONS AND DUSTY GASES
I. I. Glass, D.-L. Zhang, and J. Kaca et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 96-97 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-14330*# ITT Electro-Optical Products Div., Fort Wayne, IN.
STREAK CAMERA RECEIVER DEFINITION STUDY Final Technical Report, 28 Sep. 1989 - 26 Jun. 1990
C. B. Johnson, L. T. Hunkler, Sr., S. A. Letzring, and P. Jaanimagi (Rochester Univ., NY.) Sep. 1990 110 p
(Contract NAS5-30735)
(NASA-CR-189251; NAS 1.26:189251) Avail: NTIS HC/MF A06 CSCL 14B

Detailed streak camera definition studies were made as a first step toward full flight qualification of a dual channel picosecond resolution streak camera receiver for the Geoscience Laser Altimeter and Ranging System (GLRS). The streak camera receiver requirements are discussed as they pertain specifically to the GLRS system, and estimates of the characteristics of the streak camera are given, based upon existing and near-term technological capabilities. Important problem areas are highlighted, and possible corresponding solutions are discussed. Author

N92-14331# Arnold Engineering Development Center, Arnold Air Force Station, TN.
SIGNAL CONDITIONING OF SINGLE-ACTIVE-ARM STRAIN GAGES USED FOR DYNAMIC STRESS MEASUREMENT Final Report, 1 Oct. 1989 - 30 Jun. 1991
B. G. Mahrenholz Sep. 1991 45 p Prepared in cooperation with Sverdrup Technology, Inc., Arnold AFS TN
(AF Proj. DC9-7-EW)
(AD-A241187; AEDC-TR-91-12) Avail: NTIS HC/MF A03 CSCL 14/2

A new strain-gage signal conditioner is described for use in the measurement of dynamic stresses on turbine engine compressor blades. This conditioner has two novel circuits. A new gage excitation circuit corrects for changes in lead-wire resistance by automatically adjusting resistances in series with the leads to the gage. This maintains a balanced configuration that offers better high-frequency common-mode rejection and less broadband noise than with constant-current excitation. Another circuit in the conditioner provides system calibration by shunting a small value resistor that is in series with the gage to produce resistance change that accurately simulates the gage resistance change. The shunting is done at a rate of 1,000 times a second to produce a 1-kHz square-wave calibration signal. The calibration circuit may be used to check on the integrity of the gage and its cabling. GRA

N92-14332# California Univ., Berkeley. Lawrence Berkeley Lab.
A 2-D IMAGING HEAT-FLUX GAUGE
B. W. Noel, H. M. Borella, D. L. Beshears, W. K. Sartory, K. W. Tobin, R. K. Williams, and W. D. Turley (Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.) Jul. 1991 84 p
(Contract W-7405-eng-36)
(DE92-000153; LA-12129-MS) Avail: NTIS HC/MF A05

This report describes a new leadless two-dimensional imaging optical heat-flux gauge. The gauge is made by depositing arrays of thermorgraphic-phosphor (TP) spots onto the faces of a polymethylpentene insulator. In the first section of the report, we describe several gauge configurations and their prototype realizations. A satisfactory configuration is an array of right triangles on each face that overlay to form squares when the gauge is viewed normal to the surface. The next section of the report treats the thermal conductivity of TP's. We set up an experiment using a comparative longitudinal heat-flow apparatus to measure the previously unknown thermal conductivity of these materials. The thermal conductivity of one TP, Y_2O_3:Eu, is 0.0137 W/cm x K over the temperature range from about 300 to 360 K. The theories underlying the time response of TP gauges and the imaging characteristics are discussed in the next section. Then we discuss several laboratory experiments to: (1) demonstrate that the TP heat-flux gauge can be used in imaging applications; (2) obtain a quantum yield that enumerates what typical optical output signal amplitudes can be obtained from TP heat-flux gauges; and (3) determine whether LANL-designed intensified video cameras have sufficient sensitivity to acquire images from the heat-flux gauges. We obtained positive results from all the measurements. Throughout the text, we note limitations, areas where improvements are needed, and where further research is necessary. DOE

N92-14199# Technical Research Centre of Finland, Oulu. Electronics Lab.
OPTICAL PROXIMITY SENSOR FOR UNDERWATER MANIPULATOR APPLICATIONS
Ilkka Moring *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 129-134 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

N92-14914*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
PRACTICAL DESIGN CONSIDERATIONS AND PERFORMANCE CHARACTERISTICS OF HIGH NUMERICAL APERTURE HOLOGRAPHIC LENSES
Raymond K. Kostuk *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 211-221 Sponsored in part by IBM, and Arizona Univ., Tucson (For primary document see N92-14902 05-82)
(Grant NSF ECS-89-10067)
Avail: NTIS HC/MF A12 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-14333*# Old Dominion Univ., Norfolk, VA. Dept. of Mathematical Sciences.
THEORETICAL STUDIES OF LASERS AND CONVERTERS Progress Report, 1 Jul. - 31 Dec. 1991
John H. Heinbockel Nov. 1991 33 p
(Grant NAG1-757)
(NASA-CR-189482; NAS 1.26:189482; ODURF-176615) Avail: NTIS HC/MF A03 CSCL 20E

Discussed here is Doppler broadening and its effects upon the stimulated emission cross-section connecting an upper level with a lower level in an iodine laser. The stimulated emission cross section is given. The level transitions for the iodine laser are illustrated as are the relative intensities of these transitions. Also discussed is the Voigt profile, which considers the effect of both Doppler broadening and collision broadening upon the absorption line shape. The equations describing the Voigt profile were added to the continuous flow laser model laser simulation program. The results were compared with the standard absorption profile reported in an earlier study. There seems to be no advantage to using the Voigt profile as the laser power output is relatively insensitive to changes in the absorption cross section at the pressures being considered for a space laser. One disadvantage of using the Voigt profile is the excessive numerical computations required by the additional equations. Author

N92-14334# Ballistic Research Labs., Aberdeen Proving Ground, MD.
FUNDAMENTAL STUDIES OF LASER IGNITION AND KINETICS IN REACTIVE GASES Final Technical Report, 1 Oct. 1989 - 30 Sep. 1990
A. W. Miziolek and B. E. Forch 1 Jun. 1991 7 p
(Contract MIPR-90-0025; Proj. 2308)
(AD-A241463; AFOSR-91-0790TR) Avail: NTIS HC/MF A02 CSCL 09/3

Laser ignition experiments involving the hydrogen atom two photon resonance at 243 nm have been conducted and show an interesting isotope wavelength dependence. The results show the Incident Laser Energy (ILE) dependence for the ignition of H2/O2 and D2/O2 using a tunable laser near 243 nm. The results clearly show a wavelength shift which corresponds to 22 cm-1 at the two-photon level. This is exactly the energy difference in the n=2 excited state for the two different isotopes. Previously, we observed a similar wavelength dependence for the formation of microplasmas in flows of pure H2 and D2 gases. The results show the ignition ILE dependence on equivalence ratio for H2/O2 and D2/O2 with the laser set at the corresponding minimum wavelength points which are the wavelengths for maximum two-photon excitation. The twosets of results are basically alike as would be expected for these two fuel gases whose flame chemistry is quite similar. GRA

N92-14335# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
QUALIFICATION TESTING OF A DIODE-LASER TRANSMITTER FOR FREE-SPACE COHERENT COMMUNICATIONS
Allen D. Pillsbury and John A. Taylor 23 Jul. 1991 27 p
(Contract F19628-90-C-0002)
(AD-A241728; TR-922; ESD-TR-91-067) Avail: NTIS HC/MF A03 CSCL 25/5

A diode-laser transmitter designed for space-based coherent communications has been successfully space qualified. Environmental testing, which consisted of random vibration at levels up to 16.2g rms and thermal cycling over the range of -30 to 66 C, caused no significant degradation in the performance of the transmitter. Principal design issues and the qualification process of subassemblies and the complete transmitter are described. GRA

N92-14336# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
NEURAL NET SENSOR FUSION
R. Y. Levine and T. S. Khuon 5 Sep. 1991 44 p
(Contract F19628-90-C-0002)
(AD-A241765; TR-926; ESD-TR-91-093) Avail: NTIS HC/MF A03 CSCL 17/5

A generic architecture for neural net multisensor data fusion is introduced and analyzed. The architecture consists of a set of independent sensor neural nets, one for each sensor, coupled to a fusion net. Each sensor is trained (from a representative data set of the particular sensor) to map to a hypothesis space output. The decision outputs from the sensor nets are used to train the fusion net to an overall decision. In this report the sensor fusion architecture is applied to the stochastic exclusive-or problem for a benchmark comparison with classical hypothesis testing. The architecture is also applied to a data fusion experiment involving the multisensor observation of object deployments during the recent Firefly launches. The deployments were measured simultaneously by X and L band and CO laser radars. The range Doppler images from the X band and CO2 laser radars were combined with a passive IR spectral simulation of the deployment to form the data inputs to the neural sensor fusion system. The network was trained to distinguish predeployment, deployment, and postdeployment phases of the launch based on the fusion of these sensors. The success of the system in utilizing sensor synergism for an enhanced deployment detection is clearly demonstrated. GRA

N92-14337# International Centre for Theoretical Physics, Trieste (Italy).
MODELLING OF THE AXIAL-FLOW GAS LASER
A. R. Bestman and I. Mbeledogwu Dec. 1990 11 p
(DE91-635597; IC-90/449) Avail: NTIS HC/MF A03

A mathematical model is advanced for the axial-flow gas laser under the premise that the flow in the cylindrical tube occurs at both small Reynolds number and magnetic Reynolds number, in the presence of free convection heat transfer. Hence, the induced magnetic fields may be neglected and perturbation methods are adopted to construct analytical solutions. These solutions are discussed quantitatively. DOE

N92-14338# California Univ., Berkeley. Lawrence Berkeley Lab.
PHOTON STORAGE CAVITIES
K. J. Kim and A. M. Sessler Aug. 1991 20 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 191
(Contract DE-AC03-76SF-00098)
(DE92-000921; LBL-31195; CONF-9108118-11) Avail: NTIS HC/MF A03

A general analysis is presented of a photon storage cavity, coupled to free-electron laser (FEL) cavity. It is shown that if the coupling between the FEL cavity and the storage cavity is unidirectional (for example, a ring resonator storage cavity) then storage is possible, but if the coupling is bi-directional then storage is not possible. Parameters are presented for an infrared FEL storage cavity giving an order of magnitude increase in the instantaneous photon power within the storage cavity. DOE

N92-14339# Los Alamos National Lab., NM.
X RAYS GENERATED IN THE INTERACTION OF SUBPICOSECOND LASER PULSES WITH SOLID TARGETS
G. A. Kyrala, E. K. Wahlin, R. D. Fulton, G. T. Schappert, L. A. Jones, A. J. Taylor, D. E. Casperson, and J. A. Cobble 1991 7 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE92-000297; LA-UR-91-2900; CONF-9107115-51) Avail: NTIS HC/MF A02

We are investigating the generation of short pulse short wavelength x rays for pumping inner-shell x ray lasers by photoionization. In contrast with previous proposals, we are looking at the use of a single line as an efficient means of pumping

these lasers. As a first step we are optimizing the flashlamp x ray conversion efficiency and characterizing the x ray pulse length. DOE

N92-14340# California Univ., Berkeley. Lawrence Berkeley Lab.
DISCRETE CAVITY MODEL OF A STANDING-WAVE FREE-ELECTRON LASER
G. Rangarajan, A. M. Sessler, and W. M. Sharp (Lawrence Livermore National Lab., CA.) Aug. 1991 14 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contracts DE-AC03-76SF-00098; W-7405-eng-48)
(DE92-000839; LBL-31197; CONF-9108118-10) Avail: NTIS HC/MF A03

A standing wave free electron laser (SWFEL) has been proposed for use in a two-beam accelerator (TBA). Unlike a conventional microwave free electron laser, the SWFEL has a wiggler that is divided by irises into a series of standing wave cavities, and the beam is reaccelerated by induction cells between cavities. We introduce a one dimensional discrete-cavity model of the SWFEL. In contrast to the continuum model that has been extensively used to study the device, the new model takes into account time-of-flight effects within the cavity and applies the reacceleration field only between cavities, where the pondermotive force is absent. As in previous SWFEL models, only a single frequency is considered. Using this model, effects of finite cavity length are investigated. For moderately long cavities, it is shown that there are no adverse effects on the phase stability of the device. DOE

N92-14341# California Univ., Berkeley. Lawrence Berkeley Lab.
QUANTUM YIELD MEASUREMENTS OF PHOTOCATHODES ILLUMINATED BY PULSED ULTRAVIOLET LASER RADIATION
A. T. Young, P. Chen, W. B. Kunkel, K. N. Leung, C. Y. Li, and J. M. Watson (Superconducting Super Collider Lab., Dallas, TX.) May 1991 4 p Presented at the 1991 Institute of Electrical and Electronics Engineers (IEEE) Particle Accelerator Conference (PAC), San Francisco, CA, 6-9 May 1991
(Contract DE-AC03-76SF-00098)
(DE92-000859; LBL-29976; CONF-910505-407) Avail: NTIS HC/MF A01

The electron quantum yields from polycrystalline lanthanum hexaboride and barium irradiated by near ultraviolet laser excitation have been determined. These measurements show that the quantum yields from these materials are dependent on the processing and previous history of the photocathode material. For lanthanum hexaboride, a yield of 7 x 10(exp -6) with 337 nm irradiation has been achieved. For barium, a yield of 1 x 10(exp -6) has been measured with excitation at 308 nm. These results are discussed and future plans are outlined. DOE

N92-14342# International Centre for Theoretical Physics, Trieste (Italy).
HIGH RESOLUTION LASER SPECTROSCOPY IN COLD SUPERSONIC MOLECULAR BEAMS. COOLING, REDUCTION OF DOPPLER WIDTH AND APPLICATIONS
E. Mehdizadeh Oct. 1990 22 p
(DE91-623551; LAMP-90/3) Avail: NTIS HC/MF A03

The cooling of molecules during the adiabatic expansion of supersonic seeded molecular beams is reviewed and illustrated by the example of NO2 molecules. The reduction of the Doppler-width by collimation of the beam and the cooling to low rotational temperatures brings a significant simplification of the complex NO2 absorption spectrum and allows its assignment. The measured rotational temperature was T sub rot = 10 K. Some examples from our work illustrate this promising technique of high resolution laser spectroscopy in cold beams. DOE

N92-14343# Illinois Univ., Chicago. Lab. for Atomic, Molecular, and Radiation Physics.
MOLECULAR DESIGN CONCEPT FOR X RAY LASER RESEARCH
C. K. Rhodes, Ting Shan Luk, A. McPherson, and K. Boyer 17 Sep. 1991 11 p
(Contract DE-FG02-91ER-12108)
(DE92-000972; DOE/ER-12108/1) Avail: NTIS HC/MF A03

The goal of this program is the construction of an x ray laser in the kilovolt regime. Recent experimental results indicate that a new technique for the generation of strong amplification of x ray wavelengths is feasible. It involves the combination of (1) a new ultrahigh brightness subpicosecond laser technology, and (2) a recently discovered unique mode of strong-field interaction, particularly applicable to molecules. A concept of molecular x ray laser design emerges from these considerations which matches the mode of excitation to the structure of the molecular system. The molecular approach enables the combination of very highly electronically excited conditions with an environment characteristic of dense cold matter, a general situation exceptionally conducive to x ray amplification. Both high efficiency and wavelength tunability are intrinsic features of this method. DOE

N92-14462# Florida Univ., Gainesville.
PULSED LASER PROCESSING OF SOLAR CELLS
Rajiv K. Singh and J. Narayan (North Carolina State Univ., Raleigh.) *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 70-78 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14465# Lawrence Livermore National Lab., CA.
SOLAR PUMPING OF LASERS
Lloyd Chase *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 97-98 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14467# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
BLACKBODY PUMPED LASERS
Walter H. Christiansen *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 103-105 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SOLAR PUMPED LASERS AND THEIR APPLICATIONS
Ja H. Lee *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 106-107 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08 CSCL 20E

N92-14910*# Arizona Univ., Tucson. Optical Sciences Center.
MEASUREMENT OF LASER SPOT QUALITY
T. D. Milster and J. P. Treptau *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 181-186 Submitted for publication (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-14344*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
NONLINEAR ROTORDYNAMICS ANALYSIS Final Report
Sherif T. Noah Feb. 1991 96 p
(Contract NAS8-37465)

(NASA-CR-184263; NAS 1.26:184263) Avail: NTIS HC/MF A05 CSCL 13I

Effective analysis tools were developed for predicting the nonlinear rotordynamic behavior of the Space Shuttle Main Engine (SSME) turbopumps under steady and transient operating conditions. Using these methods, preliminary parametric studies were conducted on both generic and actual HPOTP (high pressure oxygen turbopump) models. In particular, a novel modified harmonic balance/alternating Fourier transform (HB/AFT) method was developed and used to conduct a preliminary study of the effects of fluid, bearing and seal forces on the unbalanced response of a multi-disk rotor in the presence of bearing clearances. The method makes it possible to determine periodic, sub-, super-synchronous and chaotic responses of a rotor system. The method also yields information about the stability of the obtained response, thus allowing bifurcation analyses. This provides a more effective capability for predicting the response under transient conditions by searching in proximity of resonance peaks. Preliminary results were also obtained for the nonlinear transient response of an actual HPOTP model using an efficient, newly developed numerical method based on convolution integration. Currently, the HB/AFT is being extended for determining the aperiodic response of nonlinear systems. Initial results show the method to be promising. Author

N92-14345# Defence Research Establishment Pacific, Victoria (British Columbia). Research and Development Branch.

FILTER DEBRIS ANALYSIS: A CONCRETE APPROACH TO WEAR DIAGNOSIS

H. P. Dominique and A. J. McKenzie (RE TECH Ltd., Victoria, British Columbia) Nov. 1988 29 p Original contains color illustrations

(DREP-TM-88-20; CTN-91-60271) Avail: NTIS HC/MF A03

The diagnostic merits of microscopic inspection and chemical analysis of metallic debris recovered from lubricating oil filters in a variety of oil-wetted machinery are discussed. The filter cleaning method and how it affects the amount of debris recovered is considered. The significance of representative debris levels and some criteria for establishing these levels are discussed. Abnormal debris accumulations and the corresponding mechanical malfunctions are presented to illustrate how filter debris analysis can be used to diagnose increased component wear in a variety of machinery. Merits for application of this technique for the diagnosis of machinery condition are considered. The report concludes that this method of assessing wear is particularly suited for equipment fitted with fine lubricating oil filters such as diesel, turbo-prop, and gas turbine engines and is recommended as a complement to other methods currently used for machinery condition monitoring. Author (CISTI)

N92-14346*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ROTORDYNAMIC INSTABILITY PROBLEMS IN HIGH-PERFORMANCE TURBOMACHINERY, 1990

Washington Oct. 1991 458 p Workshop held in College Station, TX, 21-23 May 1990; sponsored by Texas A and M Univ. and NASA. Lewis Research Center

(NASA-CP-3122; E-5628; NAS 1.55:3122) Avail: NTIS HC/MF A20 CSCL 13I

The present workshop continues to report field experience and experimental results, and it expands the use of computational and control techniques with the integration of damper, bearing, and eccentric seal operation results. The intent of the workshop was to provide a continuing impetus for an understanding and resolution of these problems. For individual titles, see N92-14347 through N92-14373.

N92-14347*# Thermal Power Engineering Research Inst., Xian (China).

INVESTIGATION AND CONTROL OF ROTORDYNAMIC INSTABILITY IN TYPICAL LARGE TURBOGENERATORS

Songyuan Lu *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 1-14 (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

Described here are the investigation and results of recent studies to solve oil whip in typical large turbogenerators. Included are calculations of the instability speeds and system damping of rotor-bearing systems. The polynomial-transfer matrix method which was developed by the author during the last few years is used in the calculations. Vibration measurements and data indicate the stability of these units. Research indicates that the cause of the instability lies in the three-bole offset bearings. Work was done to solve these problems, and industry tests were performed on one of these abnormal systems. Author

N92-14348*# Kyushu Electric Power Co., Inc., Fukuoka (Japan). Thermal Power Dept.

FIELD TELEMETRY OF BLADE-ROTOR COUPLED TORSIONAL VIBRATION AT MATUURA POWER STATION NUMBER 1 UNIT

Kuniyoshi Isii, Hideaki Murakami, Yasuhiko Otawara, and Akira Okabe (Hitachi Ltd., Japan) *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 15-20 (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

The quasi-modal reduction technique and finite element model (FEM) were used to construct an analytical model for the blade-rotor coupled torsional vibration of a steam turbine generator of the Matuura Power Station. A single rotor test was executed in order to evaluate umbrella vibration characteristics. Based on the single rotor test results and the quasi-modal procedure, the total rotor system was analyzed to predict coupled torsional frequencies. Finally, field measurement of the vibration of the last stage buckets was made, which confirmed that the double synchronous resonance was 124.2 Hz, meaning that the machine can be safely operated. The measured eigen values are very close to the predicted value. The single rotor test and this analytical procedure thus proved to be a valid technique to estimate coupled torsional vibration.

Author

N92-14349*# Southampton Univ. (England). Dept. of Mechanical Engineering.

THE EFFECTS OF MANUFACTURING TOLERANCES ON THE VIBRATION OF AERO-ENGINE ROTOR-DAMPER ASSEMBLIES

J. E. H. Sykes and R. Holmes *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 21-47 Sponsored in part by The Science and Engineering Research Council, England, and Rolls Royce plc (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

A range of rotor assemblies incorporating one and two squeeze film dampers with various static misalignments is investigated. Waterfall diagrams are constructed which demonstrate the effects of such misalignment and damper support flexibility on the nature and severity of subsynchronous resonance and jump phenomena. Vibration signatures of similar rotor-bearing assemblies are shown to contrast strongly due to different accumulations of tolerances during manufacture, fitting, and operation. Author

N92-14350*# Northwestern Polytechnical Univ., Xian (China). Vibration Research Council.

THE STABILITY OF THE STEADY STATE AND BISTABLE RESPONSE OF A FLEXIBLE ROTOR SUPPORTED ON SQUEEZE FILM DAMPERS

Guang Meng *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 49-62 Original language document was announced in IAA as A91-22355 Sponsored in part by Aviation Scientific Foundation of China (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

The stability of the steady state response, the bistable response, and the jumping characteristics are analyzed for the case when a

system accelerates or decelerates through the bistable region of a flexible rotor-centralized squeeze film damper system. It was found that the system steady state responses have two unstable regions. The larger the unbalance parameter and the smaller the bearing parameter and the external damping ratio, the easier it is for the system to lose stability. The larger the mass ratio and the smaller the stiffness ratio, the lower the threshold rotating speed of instability. The instability of the system steady-state response determined here is due to the system nonsynchronous response in many cases. Author

N92-14351*# University of South Florida, Tampa.
STABILITY OF INTERSHAFT SQUEEZE FILM DAMPERS
A. El-Shafei *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 63-77 Previously announced in IAA as A91-50240 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

Intershaft squeeze film dampers were investigated for damping of dual rotor aircraft jet engines. It was thought that the intershaft damper would enhance the stability of the rotor-bearing system. Unfortunately, it was determined that the intershaft squeeze film damper was unstable above the engine's first critical speed. Here, a stability analysis of rotors incorporating intershaft squeeze film dampers is discussed. A rotor model consisting of two Jeffcott rotors with two intershaft squeeze film dampers was investigated. Examining the system characteristic equation for the conditions at which the roots indicate an ever-growing unstable motion results in the stability conditions. The cause of the instability is identified as the rotation of the oil in the damper clearance. Several proposed configurations of intershaft squeeze film dampers are discussed, and it is shown that the intershaft dampers are stable supercritically only with a configuration in which the oil film does not rotate. Author

N92-14352*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
MEASUREMENTS OF PRESSURE DISTRIBUTIONS AND FORCE COEFFICIENTS IN A SQUEEZE FILM DAMPER. PART 1: FULLY OPEN ENDED CONFIGURATION
S. Y. Jung, Luis A. SanAndres, and J. M. Vance *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 79-94 Previously announced in IAA as A91-43253 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

Measurements of pressure distributions and force coefficients were carried out in two types of squeeze film dampers, executing a circular centered orbit, an open-ended configuration, and a partially sealed one, in order to investigate the effect of fluid inertia and cavitation on pressure distributions and force coefficients. Dynamic pressure measurements were carried out for two orbit radii, epsilon 0.5 and 0.8. It was found that the partially sealed configuration was less influenced by fluid inertia than the open ended configuration. Author

N92-14353*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
MEASUREMENTS OF PRESSURE DISTRIBUTIONS AND FORCE COEFFICIENTS IN A SQUEEZE FILM DAMPER. PART 2: PARTIALLY SEALED CONFIGURATION
S. Y. Jung, Luis A. SanAndres, and J. M. Vance *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 95-107 Previously announced in IAA as A91-43253 Sponsored in part by Texas A and M Univ. (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

Experimental results from a partially sealed squeeze film damper (SFD) test rig, executing a circular centered orbit are presented and discussed. A serrated piston ring is installed at the damper exit. This device involves a new sealing concept which produces high damping values while allowing for oil flow to cool the damper. In the partially sealed damper, large cavitation regions are observed in the pressure fields at orbit radii epsilon equals 0.5 and epsilon equals 0.8. The cavitated pressure distributions and the corresponding force coefficients are compared with a cavitated bearing solution. The experimental results show the significance of fluid inertia and vapor cavitation in the operation of squeeze film dampers. Squeeze film Reynolds numbers tested reach up to Re equals 50, spanning the range of contemporary applications. Author

N92-14354*# Stuttgart Univ. (Germany, F.R.). Inst. fuer Thermische Stroemungsmaschinen und Maschinenlaboratorium.
EXPERIMENTAL INVESTIGATIONS OF EXCITING FORCES CAUSED BY FLOW IN LABYRINTH SEALS
G. Thieleke and H. Stetter *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 109-134 Sponsored in part by Forschungsvereinigung Verbrennungskraftmaschinen e. V., Frankfurt/Main, Fed. Republic of Germany (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

The interaction of the flow through the labyrinth seals with the shaft of the rotor can have an effect on the stability of turbomachines. Thus, the excited forces, so-called cross forces or nonconservative forces, arise, which act perpendicular to the rotor eccentricity. This effect is caused by an unsymmetrical pressure distribution within the labyrinth cavities. Experimental studies were carried out for different types of labyrinth geometries: two staggered labyrinths with teeth on the stator and grooved rotor as well as a full and a convergent stepped labyrinth. These labyrinths can be found on the tip shrouding of bladings in steam or gas turbines. The following parameters were varied in the test facility: geometry of the labyrinth seals (number of cavities, inlet region), shaft rotation, pressure difference on the seal, entry swirl and eccentricity of the rotor. The results are presented for stiffness coefficients of the labyrinth seals, leakage flow and circumferential flow in each cavity which was measured with special probes. Generally, the inlet swirl has the greatest influence on the coefficients of the seals. The experimental results were compared with theoretical results and were in good agreement. Author

N92-14355*# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
STATIC AND DYNAMIC PRESSURE DISTRIBUTIONS IN A SHORT LABYRINTH SEAL
K. T. Millsaps and M. Martinez-Sanchez *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 135-146 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

As part of a study into turbine blade tip destabilizing forces, a seals test rig was built in which spin rate, circular whirl rate, direction and amplitude of inlet swirl angle, and eccentricity can all be controlled over wide ranges, and measurements can be made at gap Reynolds numbers up to about 2 x 10(exp 4). This facility is described and preliminary data is presented for a one cavity labyrinth seal with a flat, stator mounted land. The impact of different flow coefficients for the first and second knives on the rotordynamic coefficients was found. While this effect is dominant for the direct forces, it should also be incorporated into calculations of cross forces where it has an impact under many conditions. Author

N92-14356*# Kaiserslautern Univ. (Germany, F.R.). Dept. of Mechanical Engineering.
EVALUATION OF ROTORDYNAMIC COEFFICIENTS OF LOOK-THROUGH LABYRINTHS BY MEANS OF A THREE VOLUME BULK FLOW MODEL
R. Nordmann and P. Weiser *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 147-163 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

To describe the compressible, turbulent flow in a labyrinth seal, a three volume bulk flow model is presented. The conservation equations for mass, momentum, and energy are established in every control volume. A perturbation analysis is performed, yielding zeroth order equations for centric rotor position and first order equations describing the flow field for small rotor motions around the seal center. The equations are integrated numerically. From perturbation pressure, the forces on the shaft and the dynamic coefficients are calculated. Author

N92-14357*# Texas A&M Univ., College Station. Turbomachinery Lab.

TEST RESULTS FOR ROTORDYNAMIC COEFFICIENTS OF THE SSME HPOTP TURBINE INTERSTAGE SEAL WITH TWO SWIRL BRAKES

Dara W. Childs, Erian Baskharone, and Christopher Ramsey *In* NASA. Lewis Research Center, Rotodynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 165-178 Previously announced in IAA as A91-29469 (For primary document see N92-14346 05-37)

(Grant NAG3-181)

Avail: NTIS HC/MF A20 CSCL 13I

Test results are presented for the HPOTP Turbine Interstage Seal with both the current and an alternate, aerodynamically designed, swirl brake. Tests were conducted at speeds out to 16,000 rpm, supply pressures up to 18.3 bars, and the following three inlet tangential velocity conditions: (1) no preswirl; (2) intermediate preswirl in the direction of rotation; and (3) high preswirl in the direction of rotation. The back pressure can be controlled independently and was varied to yield the following four pressure ratios: 0.4, 0.45, 0.56, and 0.67. The central and simplest conclusion to be obtained from the test series is that the alternate swirl brake consistently outperforms the current swirl brake in terms of stability performance. The alternate swirl brake's whirl frequency ratio was generally about one half or less than corresponding values for the current design. In many cases, the alternate design yielded negative whirl frequency ratio values in comparison to positive values for the current design. The alternate design can be directly substituted into the space currently occupied by the current design. There is no change in leakage performance. Author

N92-14358*# Texas A&M Univ., College Station. Turbomachinery Lab.

SEAL-ROTORDYNAMIC-COEFFICIENT TEST RESULTS FOR A MODEL SSME ATD-HPFTP TURBINE INTERSTAGE SEAL WITH AND WITHOUT A SWIRL BRAKE

Dara W. Childs and Christopher Ramsey *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 179-190 Previously announced in IAA as A91-23654 (For primary document see N92-14346 05-37)

(Grant NAG3-181)

Avail: NTIS HC/MF A20 CSCL 13I

The predictions of Scharrer's (1988) theory for rotordynamic coefficients of labyrinth gas seals were compared with measurements for a model SSME Alternate Turbopump Development High Pressure Fuel Turbopump with and without swirl brakes. Using the test apparatus described by Childs et al., tests were conducted with supply pressures up to 18.3 bars and speeds up to 16,000 rpm. Seal back pressure was controlled to provide four pressure ratios at all supply pressures. No measurable differences in leakage was detected for the seal with and without the swirl brakes. Comparisons of the measurement results for the seal without a swirl brake with the Scharrer theory showed that the theory can be used only to provide design guidelines; systematic differences were observed between theory and experiment due to changes in running speed, supply pressure, and pressure ratio. Author

N92-14359*# Rockwell International Corp., Canoga Park, CA.

SUPPRESSION OF SUBSYNCHRONOUS VIBRATION IN THE SSME HPFTP

David G. Becht, Larry A. Hawkins, Joseph K. Scharrer, and Brian T. Murphy *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 191-202 (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

Space Shuttle Main Engine (SSME) High Pressure Fuel Turbopump (HPFTP) hot-fire dynamic data evaluation and rotordynamic analysis both confirm that two of the most significant turbopump attributes in determining susceptibility to subsynchronous vibration are impeller interstage seal configuration and rotor sideload resulting from turbine turnaround duct configuration and hot gas manifold. Recent hot-fire testing has provided promising indications that the incorporation of roughened damping seals at the impeller interstages may further increase the stability margin of this machine. A summary of the analysis which led to the conclusion that roughened seals would enhance the stability margin is presented along with a correlation of the analysis with recent test data. Author

N92-14360*# Kaiserslautern Univ. (Germany, F.R.). Dept. of Mechanical Engineering.

DETERMINATION OF ROTORDYNAMIC COEFFICIENTS FOR LABYRINTH SEALS AND APPLICATION TO ROTORDYNAMIC DESIGN CALCULATIONS

P. Weiser and R. Nordmann *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 203-221 (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

In today's rotordynamic calculations, the input parameters for a finite element analysis (FEA) determine very much the reliability of eigenvalue and eigenmode predictions. While modeling of an elastic structure by means of beam elements etc. is relatively straightforward to perform and the input data for journal bearings are usually known exactly enough, the determination of stiffness and damping for labyrinth seals is still the subject of many investigations. Therefore, the rotordynamic influence of labyrinths is often not included in FEA for rotating machinery because of a lack of computer programs to calculate these parameters. This circumstance can give rise to severe vibration problems especially for high performance turbines or compressors, resulting in remarkable economic losses. The forces generated in labyrinths can be described for small motions around the seal center with a linearized force-motion relationship. Several years ago, we started with the development of computer codes for the determination of rotordynamic seal coefficients. Our different approaches to evaluate the dynamic fluid forces generated by turbulent, compressible seal flow are introduced. Author

N92-14361*# Kobe Univ. (Japan). Faculty of Engineering.

EXPERIMENT OF STATIC AND DYNAMIC CHARACTERISTICS OF SPIRAL GROOVED SEALS

T. Iwatsubo, B. C. Sheng, and M. Ono *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 223-233 (For primary document see N92-14346 05-37)

Avail: NTIS HC/MF A20 CSCL 13I

The leakages and the dynamic characteristics of six types of spiral grooved seals are experimentally investigated. The effect of the helix angle of the seal is investigated mainly under the condition of the same nominal clearances, land and groove lengths, and groove depths. The dynamic characteristics are measured for various parameters such as preswirl velocity, pressure difference between inlet and outlet of the seal, whirling amplitude, whirling speed, and rotating speed of the rotor. The results are also compared with leakage increases with the increase of the helix angle, but as the rotating speed increases, the leakages of the larger helix angle seals quickly drop. The leakage of the smooth-stator (SS)/smooth-grooved rotor (SGR) seal drops faster than that of the spiral-grooved stator (SGS)/smooth-rotor (SR) seal. It is found that a circumferential flow can be produced by the flow along the helix angle direction, and this circumferential

flow acts as a negative swirl. For the present helix angle range, there is an optimum helix angle with which the seal has a comparatively positive effect on the rotor stability. Compared with the SGS/SR seals, the SS/SGR seal has a worse effect on the rotor stability. Author

N92-14362*# Sulzer Bros. Ltd., Winterthur (Switzerland).
ANNULAR SEALS OF HIGH ENERGY CENTRIFUGAL PUMPS: PRESENTATION OF FULL SCALE MEASUREMENT
S. Florjancic, R. Stuerchler, and T. McCloskey (Electric Power Research Inst., Palo Alto, CA.) *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 235-267 (For primary document see N92-14346 05-37)
(Contract RP-1884-10)
Avail: NTIS HC/MF A20 CSCL 13I

Prediction of rotordynamic behavior for high energy concentration centrifugal pumps is a challenging task which still imposes considerable difficulties. While the mechanical modeling of the rotor is solved most satisfactorily by finite element techniques, accurate boundary conditions for arbitrary operating conditions are known for journal bearings only. Little information is available on the reactive forces of annular seals, such as neck ring and interstage seals and balance pistons, and on the impeller interaction forces. The present focus is to establish reliable boundary conditions at annular seals. For this purpose, a full scale test machine was set up and smooth and serrated seal configurations measured. Dimensionless coefficients are presented and compared with a state of the art theory. Author

N92-14363*# Technische Univ., Munich (Germany, F.R.). Inst. of Mechanics.
HYDRAULIC ACTUATOR SYSTEM FOR ROTOR CONTROL
Heinz Ulbrich and Josef Althaus *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 269-284 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

In the last ten years, several different types of actuators were developed and fabricated for active control of rotors. A special hydraulic actuator system capable of generating high forces to rotating shafts via conventional bearings is addressed. The actively controlled hydraulic force actuator features an electrohydraulic servo valve which can produce amplitudes and forces at high frequencies necessary for influencing rotor vibrations. The mathematical description will be given in detail. The experimental results verify the theoretical model. Simulations already indicate the usefulness of this compact device for application to a real rotor system. Author

N92-14364*# General Electric Co., Cincinnati, OH. Aircraft Engines.
A SIMPLIFIED METHOD FOR PREDICTING THE STABILITY OF AERODYNAMICALLY EXCITED TURBOMACHINERY
Albert F. Storace *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 285-299 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

A method is presented for the quick and accurate prediction of the stability of aerodynamically excited turbomachinery using real eigenvalue/eigenvector data obtained from a rotordynamics model. An expression is presented which uses the modal data and the transmitted torque to provide a numerical value of the relative stability of the system. This approach provides a powerful design tool to quickly ascertain the effects of squeeze-film damper bearings, bearing location, and support changes on system stability. Author

N92-14365*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
ELECTROMECHANICAL SIMULATION OF ACTIVELY CONTROLLED ROTORDYNAMIC SYSTEMS WITH PIEZOELECTRIC ACTUATORS
Reng Rong Lin, A. B. Palazzolo, A. F. Kascak, and G. Montague (Sverdrup Technology, Inc., Brook Park, OH.) *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 301-316 Sponsored in part by Texas A and M Tubomachinery Consortium (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

Theories and tests for incorporating piezoelectric pushers as actuator devices for active vibration control are discussed. It started from a simple model with the assumption of ideal pusher characteristics and progressed to electromechanical models with nonideal pushers. Effects on system stability due to the nonideal characteristics of piezoelectric pushers and other elements in the control loop were investigated. Author

N92-14366*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
DYNAMIC CHARACTERISTICS AND STABILITY ANALYSIS OF SPACE SHUTTLE MAIN ENGINE OXYGEN PUMP
Edgar J. Gunter and Lyle Branagan *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 317-344 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

The dynamic characteristics of the Space Shuttle high pressure oxygen pump are presented. Experimental data is presented to show the vibration spectrum and response under actual engine operation and also in spin pit testing for balancing. The oxygen pump appears to be operating near a second critical speed and is sensitive to self excited aerodynamic cross coupling forces in the turbine and pump. An analysis is presented to show the improvement in pump stability by the application of turbulent flow seals, preburner seals, and pump shaft cross sectional modifications. Author

N92-14367*# Bently Rotor Dynamics Research Corp., Minden, NV.
ROTOR-TO-STATOR PARTIAL RUBBING AND ITS EFFECTS ON ROTOR DYNAMIC RESPONSE
Agnes Muszynska, Wesley D. Franklin, and Robert D. Hayashida *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 345-362 (For primary document see N92-14346 05-37)
(Contract NAS8-36719)
Avail: NTIS HC/MF A20 CSCL 13I

Results from experimental and analytical studies on rotor to stationary element partial rubbings at several locations and their effects on rotor dynamic responses are presented. The mathematical model of a rubbing rotor is given. The computer program provides numerical results which agree with experimentally obtained rotor responses. Author

N92-14368*# Rockwell International Corp., Canoga Park, CA.
THE ROCKETDYNE MULTIFUNCTION TESTER. PART 1: TEST METHOD
Brian T. Murphy, Joseph K. Scharrer, and Robert F. Sutton *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 363-374 (For primary document see N92-14346 05-37)
(Contract F04611-86-C-0103)
Avail: NTIS HC/MF A20 CSCL 13I

The Rocketdyne Multifunction Tester is a general purpose test apparatus which utilizes axial and radial magnetic bearings as shaft excitation devices. The tester is modular in design so that different seal and bearing packages can be tested on the same test stand. The tester will be used for rotordynamic coefficient extraction, as well as life and fluid/material compatibility evaluations. Use of a magnetic bearing as a shaft excitation device

opens up many possibilities for shaft excitation and rotordynamic coefficient extraction. In addition to describing the basic apparatus, some of the excitation and extraction methods are described. Some of the excitation methods to be discussed include random, aperiodic, harmonic, impulse and chirp. Author

N92-14369*# Rockwell International Corp., Canoga Park, CA.
THE ROCKETDYNE MULTIFUNCTION TESTER. PART 2: OPERATION OF A RADIAL MAGNETIC BEARING AS AN EXCITATION SOURCE
L. A. Hawkins, Brian T. Murphy, and K. W. Lang *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 375-389 (For primary document see N92-14346 05-37)
(Contract F04611-86-C-0103)
Avail: NTIS HC/MF A20 CSCL 13I

The operation of the magnetic bearing used as an excitation source in the Rocketdyne Multifunction Tester is described. The tester is scheduled for operation during the summer of 1990. The magnetic bearing can be used in two control modes: (1) open loop mode, in which the magnetic bearing operates as a force actuator; and (2) closed loop mode, in which the magnetic bearing provides shaft support. Either control mode can be used to excite the shaft; however, response of the shaft in the two control modes is different due to the alteration of the eigenvalues by closed loop mode operation. A rotordynamic model is developed to predict the frequency response of the tester due to excitation in either control mode. Closed loop mode excitation is shown to be similar to the excitation produced by a rotating eccentricity in a conventional bearing. Predicted frequency response of the tester in the two control modes is compared, and the maximum response is shown to be the same for the two control modes when synchronous unbalance loading is not considered. The analysis shows that the response of this tester is adequate for the extraction of rotordynamic stiffness, damping, and inertia coefficients over a wide range of test article stiffnesses. Author

N92-14370*# Bently Rotor Dynamics Research Corp., Minden, NV.
COMMENTS ON FREQUENCY SWEPT ROTATING INPUT PERTURBATION TECHNIQUES AND IDENTIFICATION OF THE FLUID FORCE MODELS IN ROTOR/BEARING/SEAL SYSTEMS AND FLUID HANDLING MACHINES
Agnes Muszynska and Donald E. Bently *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 391-410 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

Perturbation techniques used for identification of rotating system dynamic characteristics are described. A comparison between two periodic frequency-swept perturbation methods applied in identification of fluid forces of rotating machines is presented. The description of the fluid force model identified by inputting circular periodic frequency-swept force is given. This model is based on the existence and strength of the circumferential flow, most often generated by the shaft rotation. The application of the fluid force model in rotor dynamic analysis is presented. It is shown that the rotor stability is an entire rotating system property. Some areas for further research are discussed. Author

N92-14371*# Newcastle Polytechnic, Newcastle-upon-Tyne (England).
THE APPLICATION OF A CYLINDRICAL-SPHERICAL FLOATING RING BEARING AS A DEVICE TO CONTROL STABILITY OF TURBOGENERATORS
P. S. Leung, I. A. Craighead, and T. S. Wilkinson (NEI Parsons Ltd., Newcastle-upon-Tyne, England) *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 411-426 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

The development of a new device to control stability of turbogenerators is described. The device comprises a floating ring installed between the journal and bearing housing of a fluid film bearing. The journal and the inner surface of the ring are cylindrical while the outer surface of the ring and bearing surface are spherical providing axial location of the ring and self-alignment of the bearing. The employment of this device would lead to a consistent machine performance. System stability may be controlled by changing a number of bearing and floating ring parameters. This device also offers an additional advantage of having a very low frictional characteristic. A feasibility study was carried out to investigate the suitability of the new device to turbogenerator applications. Both theoretical analysis and experimental observations were carried out. Initial results suggest that the new floating ring device is a competitive alternative to other conventional arrangements. Author

N92-14372*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
FLUID COMPRESSIBILITY EFFECTS ON THE DYNAMIC RESPONSE OF HYDROSTATIC JOURNAL BEARINGS
Luis A. SanAndres *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 427-442 (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

A theoretical analysis for the dynamic performance characteristics of laminar flow, capillar/orifice compensated hydrostatic journal bearings is presented. The analysis considers in detail the effect of fluid compressibility in the bearing recesses. At high frequency excitations beyond a break frequency, the bearing hydrostatic stiffness increases sharply and it is accompanied by a rapid decrease in direct damping. Also, the potential of pneumatic hammer instability (negative damping) at low frequencies is likely to occur in hydrostatic bearing applications handling highly compressible fluids. Useful design criteria to avoid undesirable dynamic operating conditions at low and high frequencies are determined. The effect of fluid recess compressibility is brought into perspective, and found to be of utmost importance on the entire frequency spectrum response and stability characteristics of hydrostatic/hybrid journal bearings. Author

N92-14373*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
EFFECT OF ECCENTRICITY ON THE STATIC AND DYNAMIC PERFORMANCE OF A TURBULENT HYBRID BEARING
Luis A. SanAndres *In* NASA. Lewis Research Center, Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 Oct. 1991 p 443-459 Sponsored in part by Rockwell International Corp., and State of Texas Advanced Technology Program (For primary document see N92-14346 05-37)
Avail: NTIS HC/MF A20 CSCL 13I

The effect of journal eccentricity on the static and dynamic performance of a water lubricated, 5-recess hybrid bearing is presented in detail. The hydrostatic bearing has been designed to operate at a high speed and with a large level of external pressurization. The operating conditions determine the flow in the bearing to be highly turbulent and strongly dominated by fluid inertia effects. The analysis covers the spectrum of journal center displacements directed towards the middle of a recess and towards the mid-land portion between two consecutive recesses. Predicted dynamic force coefficients are uniform for small to moderate eccentricities. For large journal center displacements, fluid cavitation and recess position determine large changes in the bearing dynamic performance. The effect of fluid inertia force coefficients on the threshold speed of instability and whirl ratio of a single mass flexible rotor is discussed. Author

N92-14374*# Aerojet-General Corp., Sacramento, CA. Propulsion Div.
CERAMIC REGENERATOR PROGRAM Final Report, Aug. 1988 - Jun. 1991
Jerrold E. Franklin Nov. 1991 180 p Original contains color illustrations

(Contract NAS3-25416)
(NASA-CR-189053; NAS 1.26:189053; KFF-FR; RPT/F0094.93A)
Avail: NTIS HC/MF A09; 5 functional color pages CSCL 21E

The feasibility of fabricating an Air Turbo Ramjet (ATR) regenerator containing intricate hydraulic passages from a ceramic material in order to allow operation with high temperature combustion gas and to reduce weight as compared with metallic materials was demonstrated. Platelet technology, ceramic tape casting, and multilayer ceramic packaging techniques were used in this fabrication of subscale silicon nitride components. Proof-of-concept demonstrations were performed to simulate a methane cooled regenerator for an ATR engine. The regenerator vane was designed to operate at realistic service conditions, i.e., 600 psi in a 3500 R (3040 F), 500 fps combustion gas environment. A total of six regenerators were fabricated and tested. The regenerators were shown to be able to withstand internal pressurization to 1575 psi. They were subjected to testing in 500 fps, 3560 R (3100 F) air/propane combustion products and were operated satisfactorily for an excess of 100 hr and 40 thermal cycles which exceeded 2460 R (2000 F). Author

N92-14375# Aerospace Corp., El Segundo, CA.
THE EFFECT OF HYDROCHLORIC ACID PRETREATMENTS ON 440C STEEL SURFACE COMPOSITION AND THE ADHESION AND ENDURANCE OF SPUTTER-DEPOSITED MoS2 SOLID LUBRICANT FILMS
Michael R. Hilton, R. Bauer, S. V. Didziulis, and Paul D. Fleischauer 19 Apr. 1991 29 p
(Contract F04701-88-C-0089)
(AD-A241077; TOR-0090(5064)-3) Avail: NTIS HC/MF A03 CSCL 11/8

The effects of substrate pretreatment on substrate surface chemistry and on film-substrate adhesion, and film endurance (wear life) of sputter-deposited molybdenum disulfide (MoS2) on 440C bearing steel were investigated. Specifically, 20 percent hydrochloric acid/ethanol mixtures were used to etch the steel surface prior to deposition or x ray photoelectron spectroscopy (XPS). Acid etching inhibited fractures at the film-substrate interface generated by brale indentation testing. XPS indicated that the acid etching removed an iron-rich oxide surface layer, exposing a chromium-rich oxide underlayer on the steel matrix. Acid etching did not significantly affect thrust-washer sliding near life. Molybdenum disulfide is a useful solid lubricant for space applications because of its low friction, negligible vapor pressure, and tribological insensitivity to temperature (relative to liquid lubricants). Sputter deposition is a useful process for applying MoS2 onto component surfaces; the process creates a uniformly thick coating. MoS2 is routinely used in release mechanisms and on sliding electrical contacts. There is also a growing interest in using MoS2 in precision bearings. Recently, there has been a significant effort to better understand the relationship between film processing conditions and resultant film structure and composition properties. GRA

N92-14376# Department of the Navy, Washington, DC.
METHOD AND APPARATUS FOR SYNCHRONIZATION OF DYNAMICAL PHYSICAL SYSTEMS Patent Application
Louis M. Pecora, inventor (to Navy) and Thomas L. Carroll, inventor (to Navy) 19 Feb. 1991 22 p
(AD-D015020; US-Patent-Appl-SN-656330) Avail: NTIS HC/MF A03 CSCL 12/9

A synchronized nonlinear dynamical physical system is composed of first and second parts which produce output responses synchronized with respect to each other. The first part comprises a plurality of interconnected components producing intermediated responses at the junctions between the components; and the second part corresponds to a subpart of the first part selected so that the sub-Lyapunov exponents of the second part are all negative when the second part is driven by a selected at least one intermediate response applied at the at least one component junction in the second part corresponding to the at least one component junction in the first part at which the selected at least one intermediate response is produced. Author (GRA)

N92-14377# Sandia National Labs., Albuquerque, NM.
HYPERVELOCITY LAUNCH CAPABILITIES TO OVER 10 km/s
L. C. Chhabildas 1991 8 p Presented at the 13th AIRAPT International Conference on High Pressure Science and Technology, Bangalore (India), 7-11 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000242; SAND-91-1374C; CONF-9110228-2) Avail: NTIS HC/MF A02

Very high pressure and acceleration is necessary to launch flier plates to hypervelocities. In addition, the high pressure loading must be uniform, structured, and shockless, i.e., time-dependent to prevent the flier plate from either fracturing or melting. In this paper, a novel technique is described which allows the use of megabar level loading pressures, and 10(exp 9) g acceleration to launch intact flier plates to velocities of 12.2 km/s. DOE

N92-14378# Sandia National Labs., Albuquerque, NM.
PHASED-ARRAY ANTENNA CONTROL BY A MONOLITHIC PHOTONIC INTEGRATED CIRCUIT, COMPASS
S. H. Kravitz, V. M. Hietala, G. A. Vawter, and W. J. Meyer 1991 3 p Presented at the 1991 Government Microcircuit Applications Conference, Kissimmee, FL, 5-7 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000998; SAND-91-1911C; CONF-9111106-1) Avail: NTIS HC/MF A01

Phased-array antenna systems are well known for rapid beam steering and their ability to bring high power to the target. Such systems are also quite complex and heavy, which have limited their usefulness. The issues of weight, size, power use, and complexity have been addressed through a system named COMPASS (Coherent Optical Monolithic Phased Array Steering System). All phased-array antenna systems need: (1) small size; (2) low power use; (3) high-speed beam steering; and (4) digitally-controlled phase shifting. COMPASS meets these basic requirements, and provides some very desirable additional features. These are: (1) phase control separate from the transmit/receive module; (2) simple expansion to large arrays; (3) fiber optic interconnect for reduced sensitivity to EMI; (4) an intrinsically radiation-hard GaAs chip; and (5) optical power provided by a commercially available continuous wave (CW) laser. DOE

N92-14379# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MODELING AND FEEDBACK CONTROL OF A FLEXIBLE ARM OF A ROBOT FOR PRESCRIBED FREQUENCY-DOMAIN TOLERANCES
Matei Kelemen, Jacob Starrenburg, and Arunabha Bagchi Jun. 1991 33 p
(MEMO-973; ISSN-0169-2690; ETN-92-90505) Avail: NTIS HC/MF A03

The problem of achieving quantitative specifications for the tip of a rotating flexible beam with uncertainty in some of its (physical and geometric) parameters is solved. The frequency domain design method used is also helpful in clarifying some limitations on the feedback loop capabilities due to the distributed nature of the problem. Time domain simulations, while proving the validity of the design method suggested in this work, pointed to some interesting mathematical problems concerning the influence of some of the parameters on the plant dynamics, with possible physical consequences on the design of flexible beams. The laboratory experiments were compatible with the computer simulations, after overcoming the effect of the motor friction on the closed loop performance. ESA

N92-14380*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE EFFECTS OF MULTIPLE REPAIRS ON INCONEL 718 WELD MECHANICAL PROPERTIES
C. K. Russell, A. C. Nunes, Jr., and D. Moore Dec. 1991 33 p
(NASA-TM-103559; NAS 1.15:103559) Avail: NTIS HC/MF A03 CSCL 13I

Inconel 718 weldments were repaired 3, 6, 9, and 13 times using the gas tungsten arc welding process. The welded panels

were machined into mechanical test specimens, postweld heat treated, and nondestructively tested. Tensile properties and high cycle fatigue life were evaluated and the results compared to unrepaired weld properties. Mechanical property data were analyzed using the statistical methods of difference in means for tensile properties and difference in log means and Weibull analysis for high cycle fatigue properties. Statistical analysis performed on the data did not show a significant decrease in tensile or high cycle fatigue properties due to the repeated repairs. Some degradation was observed in all properties, however, it was minimal. Author

N92-13941*# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
A PROPOSED THROUGH-FLOW INVERSE METHOD FOR THE DESIGN OF MIXED-FLOW PUMPS
Joao Eduardo Borges *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 177-188 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13I

N92-13964*# Academy of Sciences (USSR), Perm. Inst. of Continuous Media Mechanics.
OPTIMAL INTERACTION OF INDENTER WITH INHOMOGENEOUS PLATE
Valery N. Aptukov *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 481-488 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-14381# Ames Lab., IA.
DEVELOPMENT OF INSTRUMENTATION FOR MAGNETIC NONDESTRUCTIVE EVALUATION Ph.D. Thesis
S. Hariharan 23 Sep. 1991 118 p
(Contract W-7405-eng-82)
(DE92-000152; IS-T-1514) Avail: NTIS HC/MF A06

The use of failure-prone components in critical applications has been traditionally governed by removing such components from service prior to the expiration of their predicted life expectancy. Such early retirement of materials does not guarantee that a particular sample will not fail in actual usage. The increasing cost of such life expectancy based operation and increased demand for improved reliability in industrial settings has necessitated an alternate form of quality control. Modern applications employ nondestructive evaluation (NDE), also known as nondestructive testing (NDT), as a means of monitoring the levels and growth of defects in a material throughout its operational life. This thesis describes the modifications made to existing instrumentation used for magnetic measurements at the Center for Nondestructive Evaluation at Iowa State University. Development of a new portable instrument is also given. An overview of the structure and operation of this instrumentation is presented. This thesis discusses the application of the magnetic hysteresis and Barkhausen measurement techniques to a number of ferromagnetic specimens. Specifically, measurements were made on a number of railroad steel specimens for fatigue characterization, and on specimens of Damascus steel and Terfenol-D for materials evaluation. DOE

N92-13963*# Khmelnitsky Technological Inst. (USSR).
ON DESIGNING FOR QUALITY
L. D. Vajingortin and W. P. Roisman *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 469-480 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 14D

N92-14196# Technical Research Centre of Finland, Espoo. Metals Lab.
DEVELOPMENT OF A CALIBRATION METHOD FOR DEEPSEA MAGNETIC PARTICLE TESTING
Thomas Aastroem *In its* Underwater Technology Symposium Apr. 1991 p 85-108 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

N92-14197# Technical Research Centre of Finland, Espoo. Lab. of Production Engineering.
TESTING A FORCE SENSOR FOR UNDERWATER MAGNETIC PARTICLE INSPECTION
Jaakko Vaelttilae *In its* Underwater Technology Symposium Apr. 1991 p 109-120 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

N92-14431# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
A CONCEPT FOR THE REVISIONS OF STRUCTURAL INSPECTION SCHEDULES
H.-J. Meyer and L. Schwarmann *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 31 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-14382# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
APPLICATION OF MSC/DYNA TO SHOCK AND IMPACT PROBLEMS IN AIRCRAFT INDUSTRY
Klaus Wolf, Ioannis Nitsopoulos, Harald Suski, and Detlef Liebe (MacNeal-Schwendler G.m.b.H., Munich, Germany, F.R.) 19 Mar. 1991 19 p Presented at the 18th MSC European Users' Conference, Prien am Chiemsee, Fed. Republic of Germany, 19-21 Jun. 1991
(MBB-UD-0593-91-PUB; OTN-021385; ETN-91-90195) Avail: NTIS HC/MF A03

Applications to important problems in aircraft industry are presented. In the first one the so called Hammershock and the flight loads are forcing the intake of a jet engine plane. The flight loads as the static part are treated with MSC/NASTRAN for efficiency, the hammershock as the highly transient with MSC/DYNA. How to combine these totally different calculations is described. The second problem is about an impact of a steel sphere on a fabric laminated plate. Using the failure criterion of SIMO-Chang, it can be shown, that, after the sphere has bounced off, the plate is partly destroyed caused by failed plies and remaining deformations. Considering the assumptions made the results of MSC/DYNA are in good agreement with the experiment. ESA

N92-14383*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
VARIATIONAL FORMULATION OF HIGH PERFORMANCE FINITE ELEMENTS: PARAMETRIZED VARIATIONAL PRINCIPLES Final Report, Mar. 1989
Carlos A. Felippa and Carmello Militello Nov. 1991 19 p Sponsored in part by Consejo Nacional de Investigaciones Cientificas y Tecnicas

(Grant NAG3-934)
(NASA-CR-189064; NAS 1.26:189064) Avail: NTIS HC/MF A03 CSCL 20K

High performance elements are simple finite elements constructed to deliver engineering accuracy with coarse arbitrary grids. This is part of a series on the variational basis of high-performance elements, with emphasis on those constructed with the free formulation (FF) and assumed natural strain (ANS) methods. Parametrized variational principles that provide a foundation for the FF and ANS methods, as well as for a combination of both are presented. Author

N92-14384# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
PHASE SPACE NAVIGATOR: TOWARDS AUTOMATING CONTROL SYNTHESIS IN PHASE SPACES FOR NONLINEAR CONTROL SYSTEMS
Feng Zhao Apr. 1991 31 p
(Contract N00014-89-J-3202; NSF MIP-90-01651)
(AD-A241160; AI-M-1286) Avail: NTIS HC/MF A03 CSCL 12/9

We develop a novel autonomous control synthesis strategy called Phase Space Navigator for nonlinear control systems, with which a controller for a nonlinear system can be automatically synthesized in phase spaces. The Phase Space Navigator generates control laws by synthesizing flow shapes of dynamical systems and planning and navigating system trajectories in the phase spaces. More specifically, the control synthesis strategy consists of a global control path planner, a local trajectory generator, and a reference trajectory follower. The global path planner finds optimal paths from an initial state to the goal state in the phase space, consisting of a sequence of path segments connected at intermediate points where the control parameter changes. A brute-force, fine-grain search in high-dimensional phase spaces would be prohibitively expensive. Modeling and parsing phase spaces into trajectory flow pipes provide a way to efficiently reason about the phase space structures and search for global control paths. The local trajectory generator uses the flow information about the phase space trajectories to produce smoothed trajectories. The trajectory follower tracks the planned reference trajectory, reactively corrects deviations, and resynthesizes the reference trajectory if the dynamics of the system changes significantly. We have demonstrated the strategy with a program that automatically synthesizes global control paths for stabilizing a steel column buckling under compression. The Phase Space Navigator is particularly suitable for synthesizing high performance control systems that do not lend themselves to traditional design and analysis techniques. It can also assist control engineers in exploring much larger design spaces than otherwise possible. GRA

N92-14385# Texas Univ., Austin.
ELASTIC SECOND-ORDER COMPUTER ANALYSIS OF BEAM-COLUMNS AND FRAMES M.S. Thesis
Hermogenes R. Munoz Aug. 1991 142 p
(Contract N00123-89-G-0531)
(AD-A241247) Avail: NTIS HC/MF A07 CSCL 20/11

At the present time, there are many applications programs available in the field of structural analysis. These programs are used for structural analysis and design. Most of these programs have graphics capability that can provide a visual representation of the behavior and response of the structure. Most of these programs are developed using sophisticated computer methods in elastic structural analysis, however, a few are designed to perform elastic second-order analysis. The use of elastic second-order analysis can be important in the design of structural systems, especially frame-type structures. In this report, the development and implementation of computerized elastic second-order analysis of frames is presented. The technique is illustrated by several examples. GRA

N92-14386# Wright Lab., Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING 1991, VOLUME 3 Final Report, Feb. 1989 - Feb. 1991
Aug. 1991 517 p Conference held in San Diego, CA, 13-15 Feb. 1991
(AF Proj. 2401)
(AD-A241313; WL-TR-91-3078-Vol-3) Avail: NTIS HC/MF A22 CSCL 20/11

Individual papers are presented, and the topics covered include the following: viscoelastic material testing and characterization, passive damping concepts, passive damping analysis and design techniques, optimization, damped control/structure interaction, viscous dampers, friction damping, other vibration suppression techniques, damping identification and dynamic testing, applications to aircraft, space structures, marine structures, commercial products, defense applications, and payoffs of vibration suppression. GRA

N92-14387# Oak Ridge National Lab., TN.
ORNL UNIFIED CONSTITUTIVE EQUATIONS ADAPTED FOR STRAIN SOFTENING AND HIGH STRAIN-RATE CONDITIONS
S. J. Chang and C. E. Pugh 1991 25 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE91-017690; CONF-911213-6) Avail: NTIS HC/MF A03

The unified creep-plasticity constitutive equations developed earlier at the Oak Ridge National Laboratory are modified to model the viscoplastic behavior of A533 grade B class 1 steel under high strain-rate conditions and yield drop at low strain rates. The development is aimed at providing an improved model for use in dynamic fracture analyses. A set of material constants is obtained from test data over the temperature range of -60 to 175 C and strain rate range of 10(exp -4) to 550 s(exp -1). The unified equations were implemented in finite element analyses to calculate the dynamic fracture parameters J(circumflex) and T* for some large wide-plate fracture experiments. The results show good agreement with fracture calculations based on other viscoplastic models. Discussion is provided on physical evidence supporting this material model. DOE

N92-14388# Sandia National Labs., Albuquerque, NM.
A CHAOTIC SYSTEM FOR THE GENERATION OF EXTREME MECHANICAL ENVIRONMENTS
T. L. Paez, D. L. Gregory, D. Kelton, and R. Coleman 1991 24 p Presented at the 3rd International Machinery Monitoring and Diagnostic Conference, Las Vegas, NV, 9-12 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE91-018358; SAND-91-0491C; CONF-911241-3) Avail: NTIS HC/MF A03

A proposed system and technique for generating high frequency, high amplitude vibration environments is presented. These environments are created using a device attached to a common vibration exciter that permits multiple metal on metal impacts driving a test surface. Previous analytical studies predicted that test environments with an energy content exceeding 10 kHz could be achieved using sinusoidal and random shaker excitations. The analysis predicted that chaotic vibrations yielding random-like test environments could be generated from sinusoidal inputs. In this study, a much simplified version of the proposed system was fabricated and tested in the laboratory. Experimental measurements demonstrate that even this simplified system, utilizing a single impacting object, can generate environments on the test surface with significant frequency content in excess of 80 kHz. A theoretical model of the system is described and the results are compared with the experimental results for the simplified system. DOE

N92-14389# Ustav Jaderneho Vyzumu, Rez (Czechoslovakia).
CONSTITUTIVE EQUATIONS FOR POLYCRYSTALLINE VOID-CONTAINING MATERIALS AND INITIATION OF SHEAR FRACTURE
J. Novak Oct. 1990 27 p
(DE91-638175; UJV-9170-M) Avail: NTIS HC/MF A03

A survey is given of the basic variants of constitutive equations with void nucleation and growth, including relations for shear and bifurcation analysis. The theory for modeling deformation of bodies containing inhomogeneities in the form of layers is described, and the results of model calculations of strain concentration and localization are summarized and compared with experimental fracture strain values. Constitutive equations are suggested for the analysis of superposition of the effects of two processes promoting strain localization, viz., crystallographical slip and void growth. The properties of the model are demonstrated and the results are compared with experimental data from the investigation of ductile fracture. DOE

N92-14390*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

INTEGRATED ADAPTIVE FILTERING AND DESIGN FOR CONTROL EXPERIMENTS OF FLEXIBLE STRUCTURES Final Report, period ended 31 Dec. 1991

Jen-Kuang Huang Nov. 1991 35 p

(Grant NAG1-830)

(NASA-CR-188627; NAS 1.26:188627) Avail: NTIS HC/MF A03 CSCL 20K

A novel method is presented of identifying a state space model and a state estimator for linear stochastic systems from input and output data. The method is primarily based on the relations between the state space model and the finite difference model for linear stochastic systems derived through projection filters. It is proven that least squares identification of a finite difference model converges to the model derived from the projection filters. System pulse response samples are computed from the coefficients of the finite difference model. In estimating the corresponding state estimator gain, a z-domain method is used. First the deterministic component of the output is subtracted out, and then the state estimator gain is obtained by whitening the remaining signal. Experimental example is used to illustrate the feasibility of the method. Author

N92-14391*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.

AIRFOIL VIBRATION DAMPERS PROGRAM Final Report

Robert M. Cook 11 Nov. 1991 242 p

(Contract NAS8-36720)

(NASA-CR-188929; NAS 1.26:188929; RI/RD-91-230; Rept-91RC13695) Avail: NTIS HC/MF A11 CSCL 20K

The Airfoil Vibration Damper program has consisted of an analysis phase and a testing phase. During the analysis phase, a state-of-the-art computer code was developed, which can be used to guide designers in the placement and sizing of friction dampers. The use of this computer code was demonstrated by performing representative analyses on turbine blades from the High Pressure Oxidizer Turbopump (HPOTP) and High Pressure Fuel Turbopump (HPFTP) of the Space Shuttle Main Engine (SSME). The testing phase of the program consisted of performing friction damping tests on two different cantilever beams. Data from these tests provided an empirical check on the accuracy of the computer code developed in the analysis phase. Results of the analysis and testing showed that the computer code can accurately predict the performance of friction dampers. In addition, a valuable set of friction damping data was generated, which can be used to aid in the design of friction dampers, as well as provide benchmark test cases for future code developers. Author

N92-14392*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.

ELECTROMAGNETIC FINITE ELEMENTS BASED ON A FOUR-POTENTIAL VARIATIONAL PRINCIPLE Final Report, Sep. 1989

James J. Schuler and Carlos A. Felippa Nov. 1991 37 p Previously announced in IAA as A90-49869

(Grant NAG3-934)

(NASA-CR-189067; NAS 1.26:189067) Avail: NTIS HC/MF A03 CSCL 20K

Electromagnetic finite elements based on a variational principle that uses the electromagnetic four-potential as a primary variable are derived. This choice is used to construct elements suitable for downstream coupling with mechanical and thermal finite elements for the analysis of electromagnetic/mechanical systems that involve superconductors. The main advantages of the four-potential as a basis for finite element formulation are that the number of degrees of freedom per node remains modest as the problem dimensionally increases, that jump discontinuities on interfaces are naturally accommodated, and that statics as well as dynamics may be treated without any a priori approximations. The new elements are tested on an axisymmetric problem under steady state forcing conditions. The results are in excellent agreement with analytical solutions. Author

N92-14393*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.

A VARIATIONAL JUSTIFICATION OF THE ASSUMED NATURAL STRAIN FORMULATION OF FINITE ELEMENTS Final Report, Jan. 1989

Carmelo Militello and Carlos A. Felippa Nov. 1991 29 p

(Grant NAG3-934)

(NASA-CR-189063; NAS 1.26:189063) Avail: NTIS HC/MF A03 CSCL 20K

The objective is to study the assumed natural strain (ANS) formulation of finite elements from a variational standpoint. The study is based on two hybrid extensions of the Reissner-type functional that uses strains and displacements as independent fields. One of the forms is a genuine variational principle that contains an independent boundary traction field, whereas the other one represents a restricted variational principle. Two procedures for element level elimination of the strain field are discussed, and one of them is shown to be equivalent to the inclusion of incompatible displacement modes. Also, the 4-node C(exp 0) plate bending quadrilateral element is used to illustrate applications of this theory. Author

N92-14394*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LANGLEY'S CSI EVOLUTIONARY MODEL: PHASE O

W. Keith Belvin, Kenny B. Elliott, Lucas G. Horta, Jim P. Bailey, Anne M. Bruner, Jeffrey L. Sulla, John Won, and Roberto M. Ugoletti (Lockheed Engineering and Sciences Co., Hampton, VA.) Nov. 1991 252 p

(NASA-TM-104165; NAS 1.15:104165) Avail: NTIS HC/MF A12 CSCL 20K

A testbed for the development of Controls Structures Interaction (CSI) technology to improve space science platform pointing is described. The evolutionary nature of the testbed will permit the study of global line-of-sight pointing in phases 0 and 1, whereas, multipayload pointing systems will be studied beginning with phase 2. The design, capabilities, and typical dynamic behavior of the phase 0 version of the CSI evolutionary model (CEM) is documented for investigator both internal and external to NASA. The model description includes line-of-sight pointing measurement, testbed structure, actuators, sensors, and real time computers, as well as finite element and state space models of major components. Author

N92-14395# Pacific Northwest Lab., Richland, WA.

ACOUSTIC EMISSION FROM STRESS CORROSION CRACK INITIATION AND GROWTH IN TYPE 304 SS

R. H. Jones and M. A. Friesel May 1991 7 p Presented at the 5th International Symposium on Environmental Degradation of Materials in Nuclear Power Systems-Water Reactors, Monterey, CA, 25-29 Sep. 1991

(Contract DE-AC06-76RL-01830)

(DE91-018827; PNL-SA-18858; CONF-9109270-1) Avail: NTIS HC/MF A02

Acoustic emission (AE) studies of intergranular stress corrosion crack (IGSCC) initiation and growth and pit initiated crack initiation have been conducted. IGSCC occurs with a moderate number of AE events, on the order of 20 ev/sq mm of crack extension, for both crack initiation and growth processes. There was no obvious

difference in the AE signal amplitude or risetime distributions for crack initiation or growth. Acoustic emission appears to emanate from plastic zone formation ahead of the crack tip and ligament or inclusion failure behind the crack. Pitting was found to occur with a significant number of AE events but there was no evidence that transgranular stress corrosion (IGSCC) produced measurable AE. The source of the AE from pitting was suggested as being from the rupture of salt caps over the pits. These results suggest that AE is a potential tool for monitoring stress corrosion cracking of reactor piping; however, development of methods to discriminate between AE from stress corrosion and other reactor noise will be necessary. DOE

N92-14396# Mound Lab., Miamisburg, OH.
THE EFFECT OF YIELD STRENGTH ON SIDE-BONDING UPSET WELDS
R. G. Miller and M. A. Perkins 24 Sep. 1991 25 p
(Contract DE-AC04-88DP-43495)
(DE92-001605; MLM-3705) Avail: NTIS HC/MF A03

During the course of 9 deg tapered side-bonding resistance upset weld development at Mound, various studies have been conducted to evaluate the effect of yield strength on welds in 304L stainless steel. The results of these studies have concluded that at high yield strengths there may be a minor reduction in the length of Class 2 or better bond. Satisfactory welds have been produced with materials having yield strengths ranging from 36.0 to 141.0 ksi. However, when body yield strengths exceed 80.0 ksi a minor decrease in bond lengths begins. A significant inverse relationship between stem yield strength and bond length was shown to exist. DOE

N92-14397# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY Review Period, Jun. 1989 - May 1991
O. Buxbaum and A. Schoepfel 1991 65 p Presented at 22d International Committee on Aeronautical Fatigue, Tokyo, Japan, 1991
(ETN-92-90317) Avail: NTIS HC/MF A04

Results of investigations in the field of fatigue gained by industry and research organizations are summarized. Most of the subjects are fatigue test results from specimens and components under constant amplitude; program and random loading. Other reports concern investigations about the cyclic stress strain behavior as well as crack propagation, fracture mechanics, and residual strength. A considerable amount of reports on investigations of composite materials, especially of graphite/epoxies and their properties under environmental influence, are included. For individual titles, see N92-14398 through N92-14431.

N92-14398# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
ABOUT THE EFFECT OF LOADING SEQUENCE ON THE FATIGUE LIFE OF NOTCHED SPECIMENS MADE FROM STEEL AND ALUMINIUM ALLOYS
O. Buxbaum, K. Klaetschke, and H. Oppermann *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

In order to investigate whether there exists a general connection between the intermixture of a loading sequence and the corresponding fatigue life of a component, the intermixture magnitude (delta) of several loading sequences was calculated: program loading sequences with constant mean loading, and continuous random loading sequences with discontinuously fluctuating mean loading. Extensive experimental results for these loading sequences were available to obtain statistically based evidence. The scale of delta reaches from 0.08 (blocked programs) to 0.47 (continuous random loading sequences with continuously fluctuating basic loading). The relative fatigue life due to a certain intermixture was defined to be the test fatigue life under the minimum intermixtured loading sequence having the same cumulative frequency distribution. ESA

N92-14399# Fachhochschule, Wilhelmshaven (Germany, F.R.).
DATABASE ON FATIGUE OF WELDED ALUMINIUM COMPONENTS ALUFAT
A. Hobbacher *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review on Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

A structure of a database on fatigue of welded aluminum components is described. The data base was structured as a relational system with three basic files. The first file is the literature management and retrieval system. Its structures is almost identical to the structure of usual literature data bases containing bibliographic data, abstracts, and keywords. It is also used to administrate the original reports, which are stored nearby the system. A literature search was carried out in all relevant data bases. The second file concerns the test description. The file is subdivided into the sections specimen description and dimensions, material description, description of weld process, special treatments, test conditions, corrosion and environment, and additional remarks. The third basic file is the data file of the individual results of the specimens. Besides the test numbers which relate the data to the test series, it contains information about applied stress for strain, stress ratio, number of cycles, failure mode, and location of crack initiation. ESA

N92-14400# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
ASSESSMENT OF THE FATIGUE BEHAVIOUR OF THE MICROALLOYED STEELS 27MnVS6 AND 38MnVS5
M. Hueck *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Results of tests to determine the fatigue properties of the two microalloyed steels 27MnVS6 and 37MnVS5 are summarized. The tests concerned the following parameters: stress concentration factors (k sub t = 1.0 to 8.2); loading (tension-compression, plane bending, rotating bending, torsion); stress ratio (R = -1 and 0); constant and variable amplitudes, the latter with two different spectra; and specimen size (d = 10 mm and 25 mm). The results are presented in S-N diagrams and Gassner curves. The S-N diagrams end at the static strength of the specimens, determined experimentally even for the plane bending specimens with a diamater of d = 25 mm. ESA

N92-14401# Technische Univ., Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Huettenmaschinen und Maschinelle Anlagentechnik.
MULTIAXIAL FATIGUE UNDER CONSTANT AND VARIABLE AMPLITUDE LOADING
C. Sanetra and H. Zenner *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Although a large amount of test series have been performed to determine the causes of damage, no essential improvement of the prediction of cumulative damage for multiaxially loaded components has been achieved. In a first step, the fatigue behavior of smooth specimens made of 30CrNiMo8 steel under combined, but in phase bending and torsion was investigated. In a second step, experiments with out-of-phase combinations were performed. The test series included pure bending, pure torsion, and several combinations. The time function is a standard random load sequence of Gaussian type with a standard load spectrum. The results are summarized and discussed. ESA

N92-14402# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
MECHANICAL PROPERTIES OF PM ALUMINIUM ALLOYS **c26**

R. Schaefer *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Within the COST 503 action, several powder metallurgy (PM) aluminum alloys were investigated. The basic objective of the project was to contribute to the assessment of the advantages which PM aluminum alloys are expected to offer compared to conventionally manufactured alloys. The contribution consisted of the evaluation of essential mechanical properties and the characterization of the microstructure of selected PM alloys produced, processed, and delivered by partners in the COST 503 action. The main emphasis was put on fatigue and fracture mechanics properties. The results demonstrate that PM technology provides the potential for improving specific properties. To reach an overall improvement the development work has to be continued. ESA

N92-14403# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
INFLUENCE OF POROSITY ON FATIGUE BEHAVIOUR OF CAST ALUMINIUM ALLOYS **c26**

C. M. Sonsino and K. Dieterich *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The difference in the results of investigations into the fatigue behavior of the age hardened alloys G-AlSi 7 Mg 0.6 wa and G-AlCu 4 Ti wa and untreated alloys G-AlSi 11 MgSr, and G-AlSi 11 Mg, and G-AlSi 11 Sr are discussed. The influence of porosity on fatigue strength is considered. With regard to the resemblance of the depicted results of both age hardened alloys, the alloy G-AlCu 4 Ti wa, which has been proved to be technically problematic in casting, can be replaced by the alloy G-AlSi 7 Mg 0.6 wa. ESA

N92-14404# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
IMPROVEMENT OF FATIGUE BEHAVIOUR OF SINTERED STEELS BY SURFACE ROLLING **c26**

C. M. Sonsino and F. Mueller *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The low strength alloy Fe-1.56 Cu (alloy A) and the high strength alloy Fe-8.0 Ni-1.0 Mo-0.5 C (alloy B) were investigated for optimized rolling forces. The following results were obtained: the low strength alloy A is in the as-sintered as well as in the surface rolled condition inferior to the respective material states of the high strength alloy B; in the unnotched condition, which is not relevant for design purposes, surface rolling improves the fatigue strength when defined at N = 2,000,000 cycles by a factor of 1.6 in the case of the alloy A and by a factor of 1.3 in the case of the alloy B; in the notched condition surface rolling improves the endurance limit defined at N = 2,000,000 cycles by a factor of more than two for both materials. It seems that the different basic strength properties have no apparent influence on the relative fatigue strength improvement by rolling: microstructural and residual stress analyses carried out in this investigation explain the prevailing mechanisms which improve the fatigue performance after rolling: these are an increased density and hardness of the surface layer as well as compressive residual stresses (and reduction of surface roughness). The obtained values for endurable stresses show that even the low strength steel A in the surface rolled condition could be a candidate for high strength applications. The knowledge of the properties determined on surface rolled samples enables the design engineer to consider this method in the design of appropriate PM components. ESA

N92-14405# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
LOW CYCLE FATIGUE OF CAST NICKEL BASE TURBINE ROTORS

J. W. Bergmann and C. M. Sonsino (Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt, Germany, F.R.) *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

A research program on rotor materials of turbochargers and gas turbines and on appropriate life prediction methods is considered. Crack initiation and short crack propagation behavior in smooth and notched specimens, simulating real hot spot areas, is experimentally determined under constant and variable amplitude loading. Crack propagation is investigated both on smooth specimens under strain control using the marker load technique and on compact tension specimens. Fatigue life prediction models for crack initiation (safe life approach) and short crack propagation (damage tolerance approach) will be checked on the basis of test results from notched specimens. Materials under investigation are IN 713 C and MAR-M-247 LC in a fine grain and hipped condition. Testing temperatures are 400, 600, and 760 C. ESA

N92-14406# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
LCF-BEHAVIOUR OF TURBINE STEELS UNDER CREVICE CORROSION CONDITIONS **c26**

E. Lachmann *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Low Cycle Fatigue (LCF) is considered. S-N tests conducted under strain control and axial loading at (R = 1) with the steam turbine rotor steel 26NiCrMoV145 and the blade steel X20Cr13 in boiler feed water of 90 C at pH7 are summarized. Details of the strain rate, strain amplitudes, oxygen content, and corrosion chamber are given. An illustration of how the gauge length of the specimens tested was covered by two halfshells in such a way that crevices of differing widths formed over the circumference of the specimen surface is illustrated. These so called crevice specimens were exposed for three months to boiler feed water at pH7 and 90 C and afterwards cycled (continuous cycling with and without hold times of 10 min in tension) in boiler feed water (pH7, 90 C). A number of the exposed specimens were stored in a desiccator for some time before cycling. Results of these tests are summarized and illustrated graphically. ESA

N92-14407# Fachhochschule, Wilhelmshaven (Germany, F.R.).
STRESS INTENSITY FACTORS FOR STRUCTURAL DETAILS OF WELDED COMPONENTS

A. Hobbacher *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Parametric formulae for the calculation of Stress Intensity Factors (SIF's) are established. For longitudinal stiffeners a sufficient number of finite element solutions is available for a parametric formula. A new formula for a welded-on flat side gusset has recently been established. Besides that, no formulae are available for the rest of the standard notch cases. The results of the analysis for a tensile strip with a welded-on flat gusset are illustrated. ESA

N92-14408# Fachhochschule, Wilhelmshaven (Germany, F.R.).
CRACK GROWTH MEASUREMENTS USING CORNER-CRACK-OR LCF-SPECIMENS

W. Oberparleiter *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397

05-39)
Avail: NTIS HC/MF A04

For determining crack growth data of engine disc materials, low cycle fatigue (LCF) or corner crack (CC) specimens are used because this type of specimen is considered to simulate the three dimensional stress field in critical locations of engine discs, such as bolt holes. While the compact tension (CT) specimen with a two dimensional through-the-thickness notch and an initial crack length much larger than the grain size of the material is used for study of crack propagation in the so called long crack regime, the CC specimen is considered ideal for determining small or short crack propagation effects for coarse grained materials. Crack propagation was measured using the DC potential method. The following conclusions are drawn. For CC specimens the crack growth rate is higher that for CT specimens at the same change in temperature and identical test parameters. Because of the smaller crack length, crack growth rates down to less than or equal to 0.000001 mm/cycle can be determined from CC specimens much better than from CT specimens. ESA

N92-14409# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
INFLUENCE OF TEST TEMPERATURE AND DWELL TIMES ON THE CRACK PROPAGATION BEHAVIOUR OF UDIMET 700 P/M-HIP
W. Oberparleiter *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations of Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Beside the production line of Udimet 700 using 45 microns from foreign supplier (A), disc semiproducts were also produced from 45 micron powder delivered by a German supplier (B). These disc semiproducts were hot isostatically pressed (HIP), forged, and aged. Crack propagation behavior and fracture toughness values were determined at different temperatures (T = 600 C and T = 650 C), loading rates and dwell times (1 sec and 30 sec) at maximum load. For this purpose, compact tension specimens of B = 14 mm and W = 28 mm were cut from one disc. Crack propagation was determined using the DC potential drop method for crack growth measurement. Fracture toughness was determined according to the ASTM-E 399 standards using the same specimens. ESA

N92-14410# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
FRACTURE TOUGHNESS AND CRACK PROPAGATION BEHAVIOUR OF ALUMINIUM 2219 T87 **c26**
A. Schoepfel, O. Peter, and W. Koehler (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The main tank of Ariane 5 containing cryogenic propellant is made of weldable aluminum alloy 2219. In order to determine fracture toughness and crack propagation behavior various series of experiments were performed using CCT specimens with a width of W = 160mm. The specimen thickness depended upon the tested condition. Investigated conditions were sheet base material (t = 4.6 mm), milled material (t = 2.4 mm), and material shot peened both at high and low intensities (t = 2.3 mm). The K sub c values and one representative crack growth curve for each batch are given. Subsequently, crack propagation tests were run on shot peened 2219 T87 material (t = 2.17 mm). Two R ratios were considered (R = 0.1 and 0.6). The results were evaluated according to Paris and Forman crack growth laws. ESA

N92-14411# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
FATIGUE OF REPAIRED COMPOSITE STRUCTURES **c24**
J. J. Gerharz, G. Danzer, and A. Maier (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F. R.) *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Investigations into the strength of repaired stringer stiffened panels of Rigidite 5245C/T800 composite laminate are summarized. The panels were fatigue loaded with modified Falstaff for wing upper surface up to three lives (18,000 flights). Surviving panels were loaded in compression up to failure (residual compressive strength test). Workshop and field repair methods were applied. The workshop repair methods consisted of flush laminate patch repairs applied to punctured skin and stringer and the field repair methods consisted of blind rivet installation in the delaminated area of nonvisible damage. The workshop repair methods used an adhesive in order to bond the patches to the reworked area of damage. The patches consisted of wet laid-up carbon fiber fabric laminate or of a laminate of fabric prepreg. The results of static and fatigue tests were dominated by the quality of the repair and the hot/wet sensitivity of the adhesive. Delamination, caused by 30 Joule low velocity impact on the skin opposite the stringer foot run out, propagated during the fatigue loading (modified Falstaff for upper wing surface). A field repair method of installing blind rivets in the delaminated area successfully delayed the delamination growth. ESA

N92-14412# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.
INVESTIGATION ON SIZE EFFECTS OF MULTIDIRECTIONAL NOTCHED CFRP LAMINATES UNDER FATIGUE LOADING **c24**
H. C. Goetting *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

A comprehensive experimental study of the influence of notch size, notch shape, and specimen width on the damage development and fatigue performance is made. Multidirectional carbon fiber reinforced plastic laminates (T300/914 C) of quasi-isotropic stacking sequence containing circular holes or sharp center notches of different size were investigated under tension-tension, compression-compression, and tension-compression with respect to the influence of specimen width. Notch sizes, and specimen widths as well as resulting aspect ratios are listed. Damage initiation and growth was observed on line by means of optical registration methods and off line by ultrasonic C-scanning and penetrant enhanced X ray radiography. Results are discussed. ESA

N92-14413# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).
ENVIRONMENTAL FATIGUE TESTS WITH COMPOSITE MATERIALS **c24**
M. Berg, D. Rott, and H. Huth *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Since the certification of composite airframe structures requires consideration of the effects of in service environmental conditions on fatigue and residual strength, two environmental test rigs for eight specimens were developed. Different graphite/epoxy materials and specimens were investigated in a variety of environmental fatigue tests using for example Falstaff and Airbus component loading sequences with superimposed thermal cycles. Some published results can be found in the references. ESA

N92-14414# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
COMPARISON BETWEEN HOT/WET TEST AND RT/DRY TEST ON THE SEASTAR HORIZONTAL STABILIZER AND FIN
C. Peters *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397

05-39)
Avail: NTIS HC/MF A04

A fatigue qualification test carried out with the horizontal stabilizer and fin of the amphibian Seastar is described. The fatigue test was carried out successfully without damage and no damage propagation was identified according to the damage types effected in the damage tolerance concept. The certification requirements were more than fulfilled because the residual strength test after three lives was also carried out successfully. By the comparison of the hot/wet test and the RT/dry test it was established that the environmental conditions led to a strength reduction of approximately 12 percent. Assuming that the temperature cycles do not reduce the strength in the fatigue test, the strength reduction occurred due to the influence of humidity. ESA

N92-14415# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.

CONSTITUTIVE RELATIONS FOR UD-LAYERS IN CROSSPLY LAMINATES DAMAGED BY FATIGUE LOADING **c24**

H. Eggers and H. C. Goetting *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Matrix splitting was studied at the inner 90 degree layers of crossply laminates. The specimens, fabricated of material T300/914C, were stressed in 0 degree by fatigue loading (R = 0.1). For the measured crack distances the residual membrane stiffnesses of the split layers were analyzed by theoretical investigations. The remaining stiffness components normal to the layers were measured directly. It was possible by a combination of tests, theory, and numerical analysis to generate the tridimensional stiffness tensor for cracked UD layers as a function of stacking order, load level, and number of load cycles. By tests and numerical analysis the Characteristic Damage States (CDS) were specified and values for the mean and the extreme crack distances were generated. The formation of layer splittings and the associated damage initiated at the interfaces and in zones close to the surface of adjacent layers, were studied. ESA

N92-14416# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).

DEVELOPMENT OF A NEW DESIGN METHOD TO PREDICT IMPACT DAMAGE TOLERANCE OF COMPOSITE STRUCTURES

J. J. Gerharz *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

A design method to predict impact damage tolerance of composite structures which needs only standard experimental investigations (fatigue testing for compliance increase) is summarized. The method is based on: characteristic states of damage; observation that buckling of impact damaged area generates the stress field causing delamination growth; and correlation of damage size (total area of delaminations) with compliance of delaminated area. The method uses laminate plate theory, stability theory, and energy consideration of Linear Elastic Fracture Mechanics (LEFM). Work started in order to diminish certain gaps of knowledge which is necessary to establish this method is listed. ESA

N92-14417# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Strukturmechanik.

INTERLAMINAR DELAMINATION GROWTH OF GRAPHITE/EPOXY COMPOSITES UNDER CONSIDERATION OF CYCLIC ENERGY RELEASE RATES FOR LIFE PREDICTION **c24**

R. Prinz *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The formation and propagation of cracks in laminates is accompanied by energy releases which also cause a reduction of the laminate stiffness. By establishing a relationship between the extent of damage and the change of stiffness, the energy release rate G and the stress intensity factors K can be determined. For the experimental evaluation of energy release rates test configurations were developed which are denoted as Transverse Crack Tension (TCT) test and Transverse Crack Tension Compression (TCTC) test. These tests take into account the damage mechanisms occurring in realistic environments. Especially the cyclically changing conditions at the crack front of delaminations subjected to tension compression loading and the unstable growth of delaminations due to buckling of delaminated plies. These tests and conclusions drawn from them are reviewed. Despite the fact that certain approximations must be made because of the complexity of issues involved in the delamination growth and the critical damage state in notched as well as unnotched multidirectional laminates, the methodology is considered a sound improvement of the qualitative and quantitative comprehension of damage mechanisms in fiber reinforced resins. ESA

N92-14418# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).

DELAMINATION IMAGING IN CFRP LAMINATES **c24**

T. Toupin and P. Popp *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Within Carbon Fiber Reinforced Plastics (CFRP) laminates, the two major critical degradation modes are delamination and intralaminar fracture. Using ultrasonic testing, different control nodes may be contemplated. The backscattering method turns out to be the best one since it allows to quantify and to locate quite accurately defects such as delamination within the material. Although delamination is well depicted by ultrasonic means, this is not the case for intralaminar fracture. Furthermore, overlapping of delamination may hamper delamination extent between each ply to be accurately estimated. For the above stated reasons and purpose of impact modeling, destructive investigations of impacted laminates were performed. This highly time consuming task enables: to determine the delamination surface between two plies and the intralaminar fracture location; to model the damage volume and to assess the main interactions between delamination and transverse fracture. These experimental findings will be used for the design of the previously indicated prediction method. ESA

N92-14419# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).

STRENGTH BEHAVIOUR OF ADHESIVELY SHRINK-BONDED SHAFT-HUB ASSEMBLIES UNDER TORSIONAL LOADING

M. Berg *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The strength behavior of adhesively shrink bonded shaft hub assemblies under torsional loading was investigated using steel specimens (C45 and 42CrMo4) with a shaft diameter of 80 mm. Static and fatigue tests were carried out to determine the influence of specimen design, stress ratio (mean stress sensitivity), and loading spectrum on strength behavior of shrink bonded assemblies. Besides the experimental investigations the complete stress state in the adhesive layer of the different specimens was analyzed using the finite element method. On the basis of the stress analytical studies and the experimental results a method for design and optimization of shrink bonded assemblies was developed. The theoretical evaluation and experimental resuits coincide quite well in all cases investigated thus showing that the procedure is suitable for practical application. Currently, the fatigue behavior of adhesively shrink bonded shaft hub assemblies under combined rotating bending and torsion is investigated. ESA

N92-14420# Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt (Germany, F.R.).

DESIGN AND FATIGUE BEHAVIOUR OF A CFRP/TITANIUM JOINT FOR THE PROPFAN ENGINE CRISP

M. Berg, O. Peter, and J. Frischbier (Motoren- und Turbinen-Union Muenchen G.m.b.H., Germany, F.R.) *In its* Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

A Counter Rotating Integrated Shrouded Propfan (CRISP) is investigated for civil aircraft application to reduce field consumption, to reduce noise, and to increase take off thrust. Limitations in size of the propfan engine and the enormous centrifugal forces caused by the fan blades, led to the use of Carbon Fiber Reinforced Plastics (CFRP) material for the blades. The design of the joint between the CFRP fan blades and the titanium blade roots is considered. A feasibility study carried out recommends a combination of riveting and adhesive bonding for the CFRP/titanium joint of the experimental propfan. The study contains recommendations of geometry, surface treatment, type of adhesive, and bonding process as well as a strength evaluation of the joint. Tests performed to evaluate the joint between titanium blade root and CFRP are listed. The experimental program will be finished by the end of 1991. ESA

N92-14421# Deutsche Airbus G.m.b.H., Hamburg (Germany, F.R.).

FATIGUE BEHAVIOUR OF CIRCUMFERENTIAL JOINTS

T. Beumler and N. Ohrloff *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

Circumferential butt joints in the upper shell of a fuselage are fatigue sensitive. Comparative fatigue tests with butt joints for two different fuselage locations were performed to check possibilities for improving the fatigue life and to develop solutions which do not require internal visual or nondestructive tests inspections. The test program included thin specimens with low secondary bending and thick specimens with high secondary bending. Possible changes to the design and their effects on the fatigue life and failure location are given. Both GLARE versions offer much fatigue life compared to the 2024 butt strap and the desired failure location in the skin. In general, the increase in fatigue life of the GLARE variants is mainly due to the very slow crack growth of the material. It also has to be shown that the joint can still carry the ultimate load at the end of the required fatigue life. This was successfully demonstrated by comparative static tests of fatigued GLARE straps. ESA

N92-14422# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).

EFFECT OF CORROSIVE ENVIRONMENT ON FATIGUE LIFE OF BONDED STEEL JOINTS

E. Lachmann *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

A review of fatigue strength investigations conducted on single lap bonded joints under constant amplitude loading (R = 0.05, f = 10 Hz) in air at ambient temperature is given. Zinc coated metal sheets (electrolytically coated and hot dipped) and three adhesive systems, one epoxy adhesive (ESP 110) and two hot melt epoxy adhesives (XW 873, XW 1044), were chosen for this study. In series A bonded joints of hot dipped zinc coated steel, sheet specimens were tested, whereas in series B, bare metal sheets bonded with electrolytically zinc coated ones were investigated. Results of tests performed to estimate the long term durability of the bonded joints and to investigate the influence of cyclic loading and corrosive attack are summarized. It is concluded that an appropriate selection of adhesive and sheet metal type gives satisfactory strength for the application of bonded steel joints to primary structural parts. Fatigue life data and stresses sustained by undamaged and pre corroded specimens are well above those of comparable spot welded joints. ESA

N92-14423# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

STATIC AND DYNAMIC STRENGTH OF JOINTS IN ARALL-LAMINATES

S. Schwantes *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

ARALL, the new hybrid sheet material, is built up from aluminum sheets, here 0.3 mm thick, and unidirectional fiber layers, 0.2 mm thick. Matrix and adhesive are epoxy materials. Two types of the material were tested, ARALL 1 with 7075 T6 sheets and prestressed fiber layer, and ARALL 2 with 2024 T3 sheets unstressed. Two specimen thicknesses were tested, 0.8 mm with one fiber layer and 1.3 mm with two. Results of tests concerning tensile strength, static properties and bearing strength of ARALL specimens are given and discussed. ESA

N92-14424# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).

PROBABILISTIC LIFING APPROACH FOR AERO ENGINE DISKS MADE OF POWDER NICKEL BASE ALLOYS CONTAINING CERAMIC DEFECTS

J. W. Bergmann, R. Heidenreich, H. Jaeckels, A. Brueckner-Foit, U. Quadfasel, H. Fischmeister, G. Koenig, and E. Affelt (Motoren- und Turbinen-Union Muenchen G.m.b.H., Germany, F.R.) *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

In a joint research program a probabilistic approach for fatigue lifing of engine disks was developed to a preliminary state. This approach is mainly based on the distribution of the size and occurrence of ceramic particles in a nickel base powder alloy disk and the scatter and type of distribution of crack propagation data. Crack propagation data was established by smooth specimen tests under constant and variable (TURBISTAN) strain controlled loading. The material under investigation was Udimet 700 as hipped in the technically pure version and in three additional versions with 20, 50 and 100 micron Al2O3 particles, which were introduced intentionally into the clean powder in a well defined fraction. The temperatures were 400C and 600C. Microstructural effects on crack propagation were recorded and will be included in the lifing approach. The probabilistic and a deterministic approach will be applied to a model disk and results will be compared. Final reports are expected in 1991. ESA

N92-14425# Deutsche Airbus G.m.b.H., Hamburg (Germany, F.R.).

AIRBUS INDUSTRIE A330/A340: FULL SCALE FATIGUE TEST OF CENTER FUSELAGE AND WING

T. Nielsen *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 3 p (For primary document see N92-14397 05-39)

Avail: NTIS HC/MF A04

Principles of the EF2 (French acronym for trial fatigue 2) test of a center fuselage and wing are given. The goal of the test is to verify that the A330/A340 structure reaches or exceeds its design goals. The A330/A340 structures are almost identical, but differ with respect to the number of engines and will be subjected to different mission profiles. One combined test specimen was defined. The test will be divided into two phases beginning with combined loads of the A340 short and medium range versions up to 40,000 flights, followed by A330 short range loading up to the test end, resulting in a total of 80,000 flights. The test specimen is illustrated and its control and loading described. Methods to

verify the damage tolerance behavior of the A330/A340 primary structure and to investigate the fatigue and damage tolerance behavior of aluminum lithium material which makes up part of the EF2 fuselage structure are summarized. ESA

N92-14426# Societe Franco-Americaine de Constructions Atomiques, Courbevoire (France).
PREDICTIONS OF FATIGUE CRACK INITIATION FROM DEFECTS IN WELDED AND CAST COMPONENTS
J.-L. Bernard, I. Meyzaud, P. Poyet, G. Baudry, C. M. Sonsino, and F. Mueller (Fraunhofer-Inst. fuer Betriebsfestigkeit, Darmstadt, Germany, F.R.) *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

In order to improve the accuracy in the treatment of components with defects, it was planned to carry out a vast range of fatigue tests with several types of steels (ferritic, austenitic) in the cast and welded state with several types of defects (shrinkages, inclusions, porosity, cracks, lacks of fusion). The influence of the defects on the fatigue behavior of the specimens was registered and a subsequent verification on large scale components with defects was foreseen. As a final result, two calculation procedures, one based on fracture mechanics and the other on the theory of elasticity, were developed. These procedures can be used to predict fatigue life to crack initiation of welded and cast specimens containing internal defects. ESA

N92-14427# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Unternehmensbereich Flugzeuge.
A CRITICAL VIEW ON THE USE OF K(f) IN RELATION TO NOTCH SIZE EFFECT
C. Boller and T. Seeger (Technische Univ., Darmstadt, Germany, F.R.) *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Notches are mainly characterized by the theoretical stress concentration factor K sub t. This assumes, however, completely elastic and homogeneous material behavior, uniaxial stresses and strains, and no scatter in material properties. With real materials these assumptions may not be valid anymore. To allow the application of these assumptions, a fatigue notch factor K sub f is introduced and defined at the endurance limit as endurable stress of an unnotched specimen to nominal stress of a notched specimen. The effects accounted for by K sub f are discussed. Experimental and numerical results for circumferentially notched round bars of different size and K sub t manufactured from low alloy steel 30CrNiMo8 and tested for the endurance limit (index E) under push pull and rotating bending are illustrated. Strength ratio versus size ratio is depicted. Each data point of the experimental results represents the mean value of several tests. No influence of loading condition or K sub t can be recognized. A significant influence is only related to the specimen and/or notch size. This influence is well described by the procedures based on the statistical size effect. The application of the procedures based in the stress gradient related size effect leads to a dependence on K sub t and an increase in unconservative prediction with increasing specimen and/or notch size, the latter being based on the assumption that K sub f can never become greater than K sub t. ESA

N92-14428# Deutsche Airbus G.m.b.H., Hamburg (Germany, F.R.).
METHODOLOGY FOR ASSESSMENT OF SKIN REPAIRS ON AIRBUS AIRCRAFT
B. Brandecker and U. Schmaelzle *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

The assessment of existing repairs on in-service aircraft, i.e., the determination of necessary inspection threshold and intervals, and/or time of modification or replacement for each repair, is discussed. Static aspects as well as fatigue and damage tolerance aspects are considered. A new methodology which includes guidance material allowing operators to assess the repairs without both complex calculation and support from the manufacturer is reviewed. For example, wing repairs cannot be generalized. The methodology is limited to the fuselage and vertical tail and comprises the following subjects: skin and longitudinal lap joint repairs; circumferential joint repairs; door skin repairs; repairs of door surrounding frames; repairs around door cut outs; repairs of vertical tail skin. As an example, the basic features of the method used for assessing skin and lap joint repairs are described. ESA

N92-14429# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
CONSTANT AMPLITUDE AND SPECTRUM LOADING FATIGUE BEHAVIOUR OF SPHEROIDAL CAST IRON
P. Heuler, M. Hueck, and H. Walter (Fischer, Georg A.G., Schaffhausen, Switzerland) *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 1 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Fatigue behavior of spheroidal cast iron was examined including static strength levels between 400 and 1,000 MPa (GGG 40 to GGG 100). Notched cylindrical specimens were tested under in plane bending at stress ratios of R = -1 and 0, respectively. The fatigue behavior under both constant amplitude loading and spectrum loading, applying a pseudo random sequence with a Gaussian cumulative frequency distribution, an irregularity factor of 0.99, and a block size of 1,000,000, was investigated. Under constant amplitude loading the finite life region as well as the endurance limit, using staircase tests, were examined. A special point of interest was the effect of cold rolling. Specimens with a stress concentration factor of K sub t = 2.8 were cold rolled, adopting different rolling parameters, but with no particular emphasis on optimization of the process variables. This type of specimen was also used to examine the possible occurrence of non-propagating cracks at stress levels below the fatigue limit of the cold rolled specimens, but above the fatigue limit of the non-rolled specimens. Results and conclusions are given. ESA

N92-14430# Technische Univ., Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Huettenmaschinen und Maschinelle Anlagentechnik.
THE EFFECT OF OVERLOADS ON LIFE-TIME
L. Jung and H. Zenner *In* Fraunhofer Inst. fuer Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 2 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

To study the effects of overloads on lifetime, torsional random fatigue tests were carried out with notched specimens made of 42CrMo4 steel in quenched and tempered condition with and without blocks of overloads. Constant amplitude tests were also performed. The results of all test series, crack initiation life, and crack propagation life, are illustrated. To take into account overloads in the life time calculation according to the Miner rule, a life time reduction factor was defined. The calculation of the factor depends on the ratio of cycles Hs/Ho and on the slope of the S-N curve. The correlation between tests and calculated life time is quite good, but so far limited to the comparatively small slope of the S-N curve. Further tests with increased slope of the S-N curve have to confirm the introduction of the lifetime reduction factor. ESA

N92-14431# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
A CONCEPT FOR THE REVISIONS OF STRUCTURAL INSPECTION SCHEDULES **c38**
H.-J. Meyer and L. Schwarmann *In* Fraunhofer Inst. fuer

Betriebsfestigkeit, Review of Investigations on Aeronautical Fatigue in the Federal Republic of Germany 1991 31 p (For primary document see N92-14397 05-39)
Avail: NTIS HC/MF A04

Revisions of established inspection schedules should not only be released in case of an in service finding, but also institutionally updated following an Airframe Condition Monitoring Procedure (ACMP). In order to improve methods and inspection procedures, it is aimed to perform an inspection just when a crack reaches its detectable length or, more realistically, to schedule inspections closer to damage. Since aircraft utilization and loading environment differ individually, a closer to damage inspection schedule must account for these differences. The basic general inspection program has to be attuned to the actual service experience for each individual aircraft. It is anticipated that reliable tools for individual aircaft tracking will soon be available and a Flexible Response Inspection Schedule (FRIS) can be established. ACMP, a software system comprising all data processing necessary to transfer collected airline sevice data into a structural inspection adjustment program, is considered. Update sequences will ensure continuing lifelong structural reassessment. Monitoring a fleet with ACMP will for the first time provide relations between aircraft utilization, including environment, and occurrence of damage. During the life of the aircraft, the Schedule for Structural Inspection (SSI) of the Maintenance Review Board (MRB) is expected to change completely from the originally supposed SSI to in service findings. Although the main objective of ACMP is to adjust inspection threshold and intervals, ACMP results can on the other hand be used to change aircraft operation in order to extend intervals or to postpone thresholds or even repair and replacement actions. ESA

N92-14432*# Analytical Services and Materials, Inc., Hampton, VA.
DELAMINATION ONSET IN POLYMERIC COMPOSITE LAMINATES UNDER THERMAL AND MECHANICAL LOADS
Roderick H. Martin Nov. 1991 58 p Presented at the ASTM Symposium on High Temperature and Environmental Effects on Polymeric Composites, San Diego, CA, 15 Oct. 1991
(Contract NAS1-19399)
(NASA-CR-189548; NAS 1.26:189548) Avail: NTIS HC/MF A04 CSCL 20K

A fracture mechanics damage methodology to predict edge delamination is described. The methodology accounts for residual thermal stresses, cyclic thermal stresses, and cyclic mechanical stresses. The modeling is based on the classical lamination theory and a sublaminate theory. The prediction methodology determines the strain energy release rate, G, at the edge of a laminate and compares it with the fatigue and fracture toughness of the composite. To verify the methodology, isothermal static tests at 23, 125, and 175 C and tension-tension fatigue tests at 23 and 175 C were conducted on laminates. The material system used was a carbon/bismaleimide, IM7/5260. Two quasi-isotropic layups were used. Also, 24 ply unidirectional double cantilever beam specimens were tested to determine the fatigue and fracture toughness of the composite at different temperatures. Raising the temperature had the effect of increasing the value of G at the edge for these layups and also to lower the fatigue and fracture toughness of the composite. The static stress to edge delamination was not affected by temperature but the number of cycles to edge delamination decreased. Author

N92-14433*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EVALUATION OF STRAIN MEASURING DEVICES FOR CERAMIC COMPOSITES
John Z. Gyekenyesi (Cleveland State Univ., OH.) and Paul A. Bartolotta Nov. 1991 24 p
(NASA-TM-105337; E-6704; NAS 1.15:105337) Avail: NTIS HC/MF A03 CSCL 20K

A series of tensile tests was conducted on SiC/reaction bonded silicon nitrides (RBSN) composites using different methods of strain measurement. The tests were used to find the optimum strain sensing device for use with continuous fiber reinforced ceramic matrix composites in ambient and high temperature environments. Bonded resistance gages were found to offer excellent performance for room temperature tests. The clip-on gage offers the same performance, but less time is required for mounting it to the specimen. Low contact force extensometers track the strain with acceptable results at high specimen temperatures. Silicon carbide rods with knife edges are preferred. The edges must be kept sharp. The strain measuring devices should be mounted on the flat side of the specimen. This is in contrast to mounting on the rough thickness side. Author

N92-14434*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON THE THERMODYNAMIC FRAMEWORK OF GENERALIZED COUPLED THERMOELASTIC-VISCOPLASTIC-DAMAGE MODELING
S. M. Arnold and A. F. Saleeb (Akron Univ., OH.) Nov. 1991 22 p
(NASA-TM-105349; E-6723; NAS 1.15:105349) Avail: NTIS HC/MF A03 CSCL 20K

A complete potential based framework using internal state variables is put forth for the derivation of reversible and irreversible constitutive equations. In this framework, the existence of the total (integrated) form of either the (Helmholtz) free energy or the (Gibbs) complementary free energy are assumed a priori. Two options for describing the flow and evolutionary equations are described, wherein option one (the fully coupled form) is shown to be over restrictive while the second option (the decoupled form) provides significant flexibility. As a consequence of the decoupled form, a new operator, i.e., the Compliance operator, is defined which provides a link between the assumed Gibb's and complementary dissipation potential and ensures a number of desirable numerical features, for example the symmetry of the resulting consistent tangent stiffness matrix. An important conclusion reached, is that although many theories in the literature do not conform to the general potential framework outlined, it is still possible in some cases, by slight modifications of the used forms, to restore the complete potential structure. Author

N92-14435*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
COMPOSITE LOAD SPECTRA FOR SELECT SPACE PROPULSION STRUCTURAL COMPONENTS Final Report
James F. Newell and Hing W. Ho Dec. 1991 78 p
(Contract NAS3-24382)
(NASA-CR-189078; NAS 1.26:189078; RI/RD-91-219) Avail: NTIS HC/MF A05 CSCL 20K

This report summarizes the development for: (1) correlation fields; (2) applications to liquid oxygen post; (3) models for pressure fluctuatios and vibration loads fluctuations; (4) additions to expert systems; and (5) scaling criteria. Implementation to computer code is also described. Demonstration sample cases are included with additional applications to engine duct and pipe bend. Author

N92-14436*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
ANALYSIS OF SUPERCONDUCTING ELECTROMAGNETIC FINITE ELEMENTS BASED ON A MAGNETIC VECTOR POTENTIAL VARIATIONAL PRINCIPLE Final Report
James J. Schuler and Carlos A. Felippa Dec. 1991 44 p
(Grant NAG3-934)
(NASA-CR-189090; NAS 1.26:189090; CU-CSSC-91-28) Avail: NTIS HC/MF A03 CSCL 20K

Electromagnetic finite elements are extended based on a variational principle that uses the electromagnetic four potential as primary variable. The variational principle is extended to include the ability to predict a nonlinear current distribution within a conductor. The extension of this theory is first done on a normal conductor and tested on two different problems. In both problems, the geometry remains the same, but the material properties are different. The geometry is that of a 1-D infinite wire. The first problem is merely a linear control case used to validate the new

theory. The second problem is made up of linear conductors with varying conductivities. Both problems perform well and predict current densities that are accurate to within a few ten thousandths of a percent of the exact values. The fourth potential is then removed, leaving only the magnetic vector potential, and the variational principle is further extended to predict magnetic potentials, magnetic fields, the number of charge carriers, and the current densities within a superconductor. The new element produces good results for the mean magnetic field, the vector potential, and the number of superconducting charge carriers despite a relatively high system condition number. The element did not perform well in predicting the current density. Numerical problems inherent to this formulation are explored and possible remedies to produce better current predicting finite elements are presented. Author

N92-14437# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
INPUT MOBILITIES AND POWER FLOWS FOR EDGE-EXCITED, SEMI-INFINITE PLATES
Christiaan Kauffmann 1991 31 p Presented at the 121st Acoustical Society of America Meeting, Baltimore, MD, 29 Apr. - 3 May 1991
(Rept-91-19; ISSN-0922-5641; ETN-92-90399) Copyright Avail: NTIS HC/MF A03

A study based on a previous analysis of the response of a semi-infinite thin plate, excited by a time harmonic load applied at a stud of finite width attached to the edge, the remainder being free, where spatial Fourier transforms in the edge direction were used to obtain closed form integral expressions for the plate response, is presented. Details of the analysis and expressions for the input power fed into the plate are presented. Numerical results covering a wide range are presented, allowing for a simple physical interpretation in three cases: point excitation; line (or beam mode) excitation; and interference effects at intermediate frequencies, that are also present in the simple acoustical analogy of a baffled piston. ESA

N92-14438# European Space Agency, Paris (France).
ACTIVE VIBRATION DAMPING OF FLEXIBLE STRUCTURE
Johann Bals (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1991 231 p Transl. into ENGLISH of Aktive Schwingungsdaempfung Flexibler Strukturen Original language document was announced as N90-29676
(ESA-TT-1217; DLR-FB-90-03; ETN-92-90740) Avail: NTIS HC/MF A11; original German version available from DLR Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 58 deutsche marks

The problem of active vibration damping for flexible structures is considered from the control theoretical point of view. Active vibration damping means that the vibrations occurring are recorded by sensors and forces which oppose the vibrations are applied to the structure by means of actuators. The task of the control law is to calculate from the sensor signals, suitable actuation signals for damping the vibrations. From the control theoretical point of view the active vibration damping problem can be subdivided into sensor actuator positioning, order reduction and controller design. Each of these are discussed. The active vibration concept was successfully applied to a generic structure. The results of a laboratory experiment are presented. ESA

N92-13935*# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
FINITE ELEMENT STRUCTURAL REDESIGN BY LARGE ADMISSIBLE PERTURBATIONS
Michael M. Bernitsas, E. Beyko, C. W. Rim, and B. Alzahabi *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 87-98 (For primary document see N92-13928 05-01)
(Contract N00014-90-J-4081)
Avail: NTIS HC/MF A99 CSCL 20K

N92-13936*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
STRUCTURAL DAMAGE IDENTIFICATION USING MATHEMATICAL OPTIMIZATION TECHNIQUES
Mo-How Herman Shen *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 99-110 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 20K

N92-14200# Technical Research Centre of Finland, Helsinki. Nuclear Engineering Lab.
DYNAMICS OF RISERS
Kari Ikonen and Jerzy Matusiak (Technical Research Centre of Finland, Espoo.) *In* Technical Research Centre of Finland, Underwater Technology Symposium Apr. 1991 p 135-148 (For primary document see N92-14190 05-31)
Copyright Avail: NTIS HC/MF A07

42 GEOSCIENCES (GENERAL)

N92-14439# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: EARTH SCIENCES
19 Nov. 1991 24 p Transl. into ENGLISH of various Russian articles
(JPRS-UES-91-006) Avail: NTIS HC/MF A03

Abstracts of Soviet publications in various areas of Earth science are presented. The areas covered include: oceanography and atmospheric physics. K.S.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-14440# Army Cold Regions Research and Engineering Lab., Hanover, NH.
INVESTIGATIONS OF FRESHWATER AND ICE SURVEYING USING SHORT-PULSE RADAR
Kevin ONeill and Steven A. Arcone Jul. 1991 30 p
(DA Proj. 4A1-61102-AT-24; DA Proj. 4A7-62784-AT-42)
(AD-A241435; CRREL-91-15) Avail: NTIS HC/MF A03 CSCL 17/9

An overview is presented of recent activities and results in the use of commercially available short-pulse UHF radar for surveying ice conditions on freshwater bodies. Improvements in radar systems have made it possible to increase ice thickness resolution by as much as one third relative to that in past attempts, and some new signal processing approaches shown here may offer an order of magnitude improvement. Results from airborne surveying are shown in which the varieties of ice character are reflected. Given the lack of ground coupling, one can rely upon a reasonably well-defined wavelet structure for enhanced signal processing and interpretation possibilities. An algorithm is presented that locates returns from interfaces in the presence of noise for a non-minimum delay wavelet. The method performs a simple inversion in the frequency domain, enhanced by a time dependent weight designed to recognize the shape of the wavelet amplitude and phase spectra. Thin ice layers are resolved down to a few centimeters and are distinguished from an ice free condition by means of a matched filter system designed to recognize the interference pattern from parallel interfaces close to one another. The effects and constraints imposed by water layers on wet ice are discussed, as are general attenuation, sloping bottom, and critical angle effects in deeper water. GRA

N92-14441# Beleidscommissie Remote Sensing, Delft (Netherlands).
ASSIMILATION OF TIR IMAGERY IN NUMERICAL MODELS AS A TOOL FOR WATER MANAGEMENT
C. F. deValk and O. C. Swertz (Technische Univ., Delft, Netherlands) Jun. 1991 57 p Original contains color illustrations
(BCRS-90-36; ETN-92-90436) Avail: NTIS HC/MF A04

A case study, conducted to assess the potential of assimilation of Thermal Infrared (TIR) imagery to improve a simulation of flow and heat transport in a relatively simple situation is considered. The case study involved the construction of a numerical model of flow and heat transport in a section of the river Waal (Netherlands) downstream from the cooling water discharge of a power plant. A TIR temperature image was processed for use in calibration of the model. The sensitivity of the model input for several input data was assessed, in order to identify the model input data that can be reconstructed from a TIR image of the area. The application of a simple variational method for the reconstruction of model inputs was tested, with measured and synthetic TIR data and field data. Conclusions and recommendations are summarized.
ESA

N92-14442# Beleidscommissie Remote Sensing, Delft (Netherlands).
MODELLING AND SYNERGETIC USE OF OPTICAL AND MICROWAVE REMOTE SENSING. REPORT 2: LAI ESTIMATION FROM CANOPY REFLECTANCE AND WDVI: A SENSITIVITY ANALYSIS WITH THE SAIL MODEL
J. G. P. W. Clevers and W. Verhoef (National Aerospace Lab., Amsterdam, Netherlands) Jul. 1991 75 p
(BCRS-90-39; ETN-92-90437) Avail: NTIS HC/MF A04

After reviewing potential vegetation indices and reflectance models for Leaf Area Index (LAI) estimation of agricultural crops, a sensitivity analysis is performed with the SAIL reflectance model towards the influence of disturbing factors on the LAI estimation from canopy reflectance and WDVI (Weighted Difference Vegetation Index). The WDVI was developed as part of the CLAIR model for correcting the near infrared reflectance for soil background. From the SAIL simulations it is concluded that the influence of external factors (soil reflectance, ratio diffuse/total irradiation and solar view geometry) will not pose a large problem for the relationship between LAI and WDVI. However, crop parameters other than LAI have a significant influence on the relationship between WDVI and LAI. Actual information on these parameters mostly is lacking. Since often these parameters (such as leaf inclination, leaf reflectance and leaf transmittance) change only gradually during crop growth, their influence is caught in the two empirical parameters of the CLAIR model, which are estimated from a training set.
ESA

N92-14443# Beleidscommissie Remote Sensing, Delft (Netherlands).
APPLICATION OF SPOT IN THE TAI AREA (IVORY COAST) [TOEPASSING VAN SPOT IN HET TAI GEBIED (IVOORKUST)]
M. A. Mulders and M. Pijpers (Wageningen Agricultural Univ., Netherlands) Jun. 1991 41 p In DUTCH; ENGLISH summary Original contains color illustrations
(BCRS-90-41; ETN-92-90438) Avail: NTIS HC/MF A03

SPOT remote sensing data were used for soil and vegetation mapping of the national park Tai on the Ivory Coast. Each remote sensing product has its own value, but also limitations, especially with respect to the processing of data concerning tropical forests and adjacent lands. SPOT data of three bands were available with limited spectral information compared with thematic mapping. The data set was extended with different combinations of these three bands up to a set of seven variables. The lowest correlating set of three variables was selected for image production. The image and a SPOT band combination was interpreted besides an image produced by unsupervised classification. An interpretation map with reasonable distinction of land cover using stepwise interpretation of three images and using spectral differences is considered.
ESA

N92-14444# Beleidscommissie Remote Sensing, Delft (Netherlands).
MEASUREMENTS WITH SHIRA IN THE ERS-1 REHEARSAL CAMPAIGN [METINGEN MET SHIRA IN DE REHEARSAL CAMPAGNE VAN DE ERS-1]
Jan C. M. Kleijweg and J. H. Teeuwen (Physics and Electronics Lab. TNO, The Hague, Netherlands) Mar. 1991 45 p In DUTCH; ENGLISH summary
(BCRS-91-03; ETN-92-90439) Avail: NTIS HC/MF A03

Oceanographical and meteorological measurements were performed simultaneously using the shipborne radar system SHIRA, in order to estimate on-line two dimensional wavenumber spectra. These measurements were performed in the framework of the Rehearsal campaign Northern Europe (RENE) for the ERS-1, organized by ESA from February 5 until March 8 1990. During the measurements, the wind force varied from 8 to 12 Beaufort, predominantly from southwest, resulting in waves with long wavelength and high amplitude. In spite of the extreme weather conditions, SHIRA functioned excellently and produced a great number of reliable results. However, a lot of in situ measurement failed, including all the two dimensional wavebuoy measurements. Therefore the validation of SHIRA with two dimensional wavebuoy spectra was not carried out.
ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-14445# National Academy of Sciences - National Research Council, Washington, DC. Committee on Potential Applications of Concentrated Solar Photons.
POTENTIAL APPLICATIONS OF CONCENTRATED SOLAR ENERGY
1991 159 p Workshop held in Golden, CO, 7-8 Nov. 1990 Sponsored in part by the Midwest Research Inst.
(NAP-S-416; LC-91-62494; ISBN-0-309-04577-0) Avail: NTIS HC/MF A08

A workshop was convened to assess the current state of the field, in a number of potential applications, and to discuss technologies for which concentrated solar energy might be utilized. The workshop was held at the facilities of the Solar Energy Institute. This proceeding is the record of that workshop containing all the summary papers submitted by the speakers as well as the rapporteur reports summarizing the presentations and the discussion. Papers were submitted in the following areas: water treatment, waste treatment, materials processing and synthesis, solar pumping of lasers, photochemical synthesis, fuel processing and thermochemical/photochemical cycles, and advanced research topics. For individual titles, see N92-14446 through N92-14479.

N92-14446# Environmental Protection Agency, Athens, GA. Environmental Research Lab.
WATER TREATMENT: ADVANCED PHOTOOXIDATION PROCESSES **c45**
Richard G. Zepp *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 1-5 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

A report from the rapporteur, for the first session during a workshop held by the Committee on Potential Applications of Concentrated Solar Photons, is presented. Systems for photooxidation water treatment are considered. Among the systems mentioned are treatment techniques that rely on the following: ultraviolet light, ozone, hydrogen peroxide, and photocatalysis. Factors effecting water treatment efficiencies are discussed.
D.R.D.

N92-14447# North Carolina Univ., Chapel Hill. Dept. of Environmental Science and Engineering.
CHEMICAL MODELS OF ADVANCED OXIDATION PROCESSES **c45**
William H. Glaze *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 6-8 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Advanced oxidation processes (AOPs) have been defined as ambient temperature processes which involve the generation of highly reactive oxyradicals, especially the hydroxyl radical. These processes show promise for the destruction of hazardous organic substances in municipal and industrial wastes and in drinking water. Four types of AOPs are considered: base catalyzed decomposition of ozone; ozone with hydrogen peroxide; UV photolysis of ozone; and UV photolysis of hydrogen peroxide. Author

N92-14448# Midwest Research Inst., Golden, CO.
MECHANISTIC STUDIES OF THE PHOTOCATALYTIC BEHAVIOR OF TiO2 PARTICLES IN A PHOTOELECTROCHEMICAL SLURRY CELL AND THE RELEVANCE TO PHOTODETOXIFICATION REACTIONS **c45**
M. W. Peterson, J. A. Turner, and Arthur J. Nozik *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 9-15 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The photooxidizing and photocatalytic properties of suspensions of semiconducting TiO2 particles are discussed. Because TiO2 has the ability to completely oxidize a large number of hazardous materials to nontoxic products, it has become the benchmark semiconductor for use on a variety of schemes for the photodetoxification of contaminated water. Therefore, a mechanistic study of photooxidation processes on TiO2 particles using a photoelectrochemical slurry cell was undertaken. Author

N92-14449# Midwest Research Inst., Golden, CO.
EFFECT OF LIGHT INTENSITY ON PHOTOCATALYTIC REACTION **c45**
Craig S. Turchi *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 16-19 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

As more research effort has focused on the area of photocatalysis, it has become more important to determine the fundamental behavior of the photocatalytic reactions in order to promote economic analysis and eventual commercialization of this technology. One such parameter is the effect of ultraviolet light intensity on the observed rate of pollutant destruction. Data concerning the effect of light intensity on the rate of photocatalytic degradation of organic water contaminants is summarized. Author

N92-14450# Illinois State Water Survey, Champaign.
A COMPARISON OF ADVANCED OXIDATION PROCESSES WITH SEMICONDUCTOR-CATALYZED PHOTO-OXIDATION **c45**
Gary R. Peyton *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 20-21 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Hydroxyl is a powerful, indiscriminate oxidant. The Advance Oxidation Processes (AOPs) represent an attempt to take advantage of this reactivity. Semiconductor Catalyzed PhotoOxidation (SCPO) was introduced in the late 1970's. This class of processes has also been demonstrated to be effective on a wide range of organic contaminants. A comparison of AOPs with SCPO is presented. Author

N92-14451# Ultrox International, Inc., Santa Ana, CA.
ULTROX OPERATING EXPERIENCES WITH UV/OXIDATION; ECONOMICS **c45**
Jack D. Zeff *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 22-24 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

There has been a need for more powerful oxidizing methods which do not produce hazardous by products. The development and application of enhanced ultraviolet light oxidation of organic chemicals in wastewaters, drinking waters, leachates, and groundwaters is described. The oxidants used in these application are ozone an hydrogen peroxide. Author

N92-14452# Midwest Research Inst., Golden, CO.
SOLAR PHOTOCATALYZED PROCESS ECONOMICS **c45**
Hal Link *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 25-27 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The Solar Energy Research Institute (SERI) cost estimates for solar water detoxification systems based on the best available information as of October 1990 are discussed. Comparative costs are also provided for competitive conventional technologies which are presently applied in the water detoxification market. Although costs for solar photocatalytic systems are presently higher than those of competitive technologies, cost and performance improvements should lead to cost competitiveness by 1995. Author

N92-14453# NuLite, London (Ontario).
PHOTOCATALYZED REMOVAL OF MULTIPLE CONTAMINANTS FROM WATER **c45**
Hussain Al-Ekabi *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 28-29 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The TiO2 advanced photo-oxidation process has just recently begun to show considerable promise in removing organic pollutants from water streams. However, one of the major practical problems when using semiconductors as photocatalysts is the hole-electron recombination process. This process is extremely efficient and thus represents a major energy wasting step. For instance, the quantum yield for TiO2 photocatalytic degradation of some organic compounds has been reported to be less than 5 percent. As a result, there exists a challenging opportunity to improve the degradation rate of organic pollutants by preventing the hole-electron recombination process. This is an important consideration prior to commercial application of the TiO2 technology for water treatment. One strategy for inhibiting the hole-electron recombination process is to add efficient (preferably irreversible) electron acceptors to the reaction. These additives should fulfill the following criteria in order to efficiently inhibit the recombination process: (1) readily accept excess conduction band electrons or electrons from the superoxide ions; (2) then rapidly dissociate into harmless products; and (3) provide additional routes for the formation of OH radicals or other powerful oxidizing agents. So far we have examined four additives: oxygen, hydrogen peroxide, ozone, and persulfate and have found the results very promising. For instance, the effect of H2O2 on the degradation of a mixture of four chlorinated phenols (10 ppm each) is shown. Clearly, H2O2 markedly increases the degradation rate of all the components involved in this mixture. The degradation rate of a mixture of organic pollutants containing toluene, chlorobenzene, ethylbenzene, nitrobenzene, p-xylene, and o-cresol (10 ppm each) has also markedly increased when H2O2 was added to the solution prior to the irradiation. Similar results were obtained with other additives. Various experimental parameters were investigated and results will be presented. Author

N92-14454# Midwest Research Inst., Golden, CO.
IMMOBILIZED CATALYSTS IN SOLAR CONCENTRATORS **c45**
Mark S. Mehos *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 30-31 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Experiments have demonstrated that many of the desired characteristics of an immobilized catalyst, e.g., good performance, low pressure drop, and low cost, can be achieved using a commercially available, immobilized catalyst. Experiments have indicated, however, that the activity of the immobilized catalyst decreases following a high level of initial activity. Additionally, experiments have shown a dependence of the destruction efficiency on the flow rate through the photoreactor. The design of a reactor containing an immobilized catalyst for use in the destruction of contaminated water requires that improvements be made. Most importantly, research needs to identify causes and prevention of the observed limitations in catalyst lifetime. If the lifetime of the catalyst cannot be sustained, methods must be determined for economically regenerating the catalyst, preferably without removing the catalyst from the photoreactor. Similarly, future reactor designs must reduce or eliminate the observed dependence of destruction on flow rate. These problems are currently being investigated by in-house researchers at the Solar Energy Research Institute and Sandia and will soon be investigated through industry/university subcontracts. Resolution of these issues will increase the likelihood of the competitiveness of solar detoxification systems. Author

N92-14455# Sandia National Labs., Albuquerque, NM. Solar Thermal Collector Technology Div.
PHOTOCATALYSIS WITH LARGE-SCALE TROUGH COLLECTORS **c45**
James E. Pacheco *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 32-33 (For primary document see N92-14445 05-44)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC/MF A08

Sandia National Laboratories' part in the Department of Energy's Solar Detoxification of Hazardous Waste Initiative is focused on conducting large-scale solar photocatalytic experiments. Sandia's efforts support fundamental laboratory research performed by the Solar Energy Research Institute (SERI), which will lead to the first field experiment in about one year. In Sandia's facility, water spiked with a contaminant, flows through a glass pipe reactor centered at the focus of a parabolic trough. The ultraviolet portion of the concentrated sunlight activates the titanium dioxide to form oxidizers which have the ability to decompose many organic compounds. Sandia's facility consists of six parabolic troughs in series. These troughs were originally installed to demonstrate the potential of using solar energy to produce industrial process heat or steam for electricity generation. We modified the system by removing the original black receiver pipes and installing borosilicate glass pipes in their place to serve as a photoreactor. The troughs have aluminized acrylic film that has a reflectivity of approximately 70 percent in the near ultraviolet (300-400 nm). These troughs concentrate ultraviolet sunlight about 35 times. The system is equipped with two 3800 liter (1000 gallon) tanks used for reservoirs of test solution and one 3800 liter tank for holding clean water, and can be operated in either recirculating or single pass modes at flow rates up to 100 liters per minute (26 gallons per minute). We have conducted numerous tests with trichloroethylene (TCE), trichloroethane (TCA), salicylic acid, and textile dyes. We varied the initial concentration of TCE from 100 to 5000 parts per billion (ppb) and found that the normalized data could be described by one curve with only two parameters. We have examined the effect of intensity on the destruction of TCE by measuring the destruction rate at different times in the day. We used these measurements and combined them with models of the variation of ultraviolet with air mass along with Typical Meteorological Year (TMY) solar radiation data for a number of sites to estimate processing rates for solar detoxification systems. We also did a series of experiments to measure reaction rate of TCA alone and in the presence of TCE at concentrations of 2000 ppb. Author

N92-14456# Pasternak (Alan D.), Lafayette, CA.
WASTE TREATMENT **c45**
Alan D. Pasternak *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 35-37 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The session on waste treatment included five speakers. The topics covered were the fundamentals of waste treatment economics, high temperature photochemistry, the fundamentals of combustion kinetics, and research and development of techniques for destroying hazardous and mixed hazardous and radioactive wastes. Two kinds of applications of solar energy in waste treatment were identified: as a source of solar photons for thermal photolytic destruction of organic compounds at high temperatures (but temperatures that are lower than would be required without solar photons) and as a source of thermal energy in thermal destruction processes. Research and development related to solar applications in waste treatment is needed in the mechanisms of photolysis, particularly at high temperatures, and in the engineering of practical systems. Author

N92-14457# Dayton Univ., OH. Environmental Sciences Group.
HIGH-TEMPERATURE PHOTOCHEMISTRY INDUCED BY CONCENTRATED SOLAR RADIATION **c45**
Barry Dellinger, John Graham, Joel M. Berman, and Don Klosterman *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 38-47 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Available results for the destruction of hazardous wastes using concentrated solar radiation clearly suggest that many compounds are amenable to destruction through direct absorption and unimolecular decomposition, while other weak or nonabsorbing species may also be amenable to destruction through secondary photoinduced, radical molecule reaction pathways. However, for a technology to compete successfully in the waste disposal market, it must demonstrate a technological, cost, or possible social advantage over the available techniques. The principal competition at this point is controlled thermal incineration. The advantages of solar destruction over thermal destruction are outlined as well as apparent major disadvantages. Our task is to develop an approach that utilizes the advantages to offset or minimize the disadvantages. One approach is to develop a hydrid two stage system targeted for detoxification of contaminated soil and other solids. With this concept, a hybrid primary unit may be used to thermally desorb toxic organics from solids, while a secondary solar reactor would be used to thermal-photolytically destroy the desorbed organics. The excess thermal energy generated in the photoreactor would be used to heat the solid waste in the primary unit. This solar generated thermal energy can be supplemented with auxiliary indirect heating from a gas-fired burner. Author

N92-14458# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Kinetics Div.
CHEMICAL PROCESSES DURING INCINERATION AND IMPLICATIONS OF DETOXIFICATION OF HAZARDOUS WASTES USING SOLAR PHOTONS **c45**
Wing Tsang *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 48-50 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

A review is given of the chemistry of incineration. The aim is to demonstrate that it is possible to explain in semiquantitative terms the nature of failure mechanisms. There are no thermodynamic barriers to the transformation of any organic molecules during incineration to their thermodynamic end states. In other words, if one can confine an organic molecule in a hypothetical incineration environment for sufficient time, the destruction is total. Failure must, therefore, be due to kinetic effects. These can be divided into physical and chemical. Interest here is in the latter. These chemical reaction pathways are examined. The use of solar photons in direct photodecomposition or thermal decomposition is explored. Author

N92-14459# Chemical Waste Management, Inc., Geneva, IL.
SOLAR TECHNOLOGY APPLICATIONS IN CHEMICAL WASTE MANAGEMENT **c45**

Peter S. Daley *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 51-57 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

An assessment of the potential for using solar energy to destroy waste chemicals and toxic materials is presented. Various economic and environmental factors that influence the viability of waste management technologies are addressed. It is concluded that solar-based technologies offer limited opportunities for chemical waste applications because they add additional capital costs and system complexity without providing proportional energy savings. This is largely because energy is not a major factor in most chemical waste disposal activity. Overhead associated with regulatory compliance, chemical analysis, feed preparation, residuals disposal, environmental permit, etc., typically dominates the cost equation. In addition, the great importance given to treatment reliability means that solar energy sources would require conventional energy backup in most applications. Further reducing the likelihood of success for solar-based applications is that the niches open to the approach are likely to be too small to justify the development costs. One niche that is promising is solar systems for treatment of groundwater at remote sites. In this case, intermittent operation is acceptable, even desirable, and energy costs are high. M.G.

N92-14460# Stanford Univ., CA. Dept. of Materials Science and Engineering.
MATERIALS PROCESSING AND SYNTHESIS c45
Bruce M. Clemens *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 59-63 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The third session of the workshop on Applications of Concentrated Solar Energy is summarized and suggestions for future research and development are given. The summarized papers addressed the following topics: (1) current surface modification and thin film growth technologies; (2) possible applications of solar techniques to materials processing and synthesis; and (3) economic analyses related to the application of solar furnaces. M.G.

N92-14461# Argonne National Lab., IL.
APPLICATIONS OF ENERGETIC PARTICLES IN IMPROVING COATING ADHESION PROPERTIES c27
George R. Fenske *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 64-69 (For primary document see N92-14445 05-44)
(Contract W-31-109-eng-38)
Avail: NTIS HC/MF A08

The use of energetic ions or atoms to enhance the adhesion of coatings to substrate materials is reviewed with particular attention being given to ion beam assisted deposition (IBAD). The application of concentrated solar beams as an alternative to using energetic ions is then discussed. With pyrolytic approaches, intense solar beams could be used to heat substrates and vapor sources to elevated temperatures. Unlike conventional substrate heating for physical vapor deposition, solar heating would not require the heating procedure to be performed in a vacuum. In addition, the solar heating could be carried out in a reactive environment to chemically assist the formation of volatile compounds from the surface contaminants. Concentrated solar beams could also be used to deposit films. A process known as photo-enhanced chemical vapor deposition (PHCVD) is receiving considerable attention in semiconductor applications as a low-temperature process for deposition of Si, SiO2, and GaAs. The process is based on the photodissociation of gas phase molecules and typically uses UV light and/or excimer lasers to break chemical bonds. Author

N92-14462# Florida Univ., Gainesville.
PULSED LASER PROCESSING OF SOLAR CELLS c36
Rajiv K. Singh and J. Narayan (North Carolina State Univ., Raleigh.) *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 70-78 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Pulsed nanosecond excimer lasers can be effectively used for fabrication of silicon based solar cells having controlled junction depths and sheet resistivities, and high minority carrier lifetimes. By using pulsed beams, the ion implanted layers are melted and the underlying defect-free crystal provides a seed for subsequent crystal growth, resulting in 100 percent electrical activation of the dopant atoms. The understanding of the laser-solid interactions provides insight into the thermal effects of solids irradiated with pulsed laser beams. For metallization of the p-n junctions, the excimer laser beams can also be used to deposit stoichiometric good quality TiN thin films by evaporation of bulk TiN targets. Author

N92-14463# Midwest Research Inst., Golden, CO. PD Measurements and Performance Branch.
SURFACE MODIFICATION TECHNOLOGIES USING CONCENTRATED SOLAR RADIATION
J. Roland Pitts, J. T. Stanley, Ed Tracy, and C. L. Fields (University of Northern Colorado, Greeley.) *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 79-83 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Research conducted at the Solar Energy Research Institute (SERI) during the past three years addressed a number of the critical areas and has explored the possibility of using highly concentrated solar radiation to induce beneficial surface transformation. The principal goal is to develop new coatings and processes that improve the performance and lifetime of materials at reduced processing costs. Highly concentrated radiant energy provides a controllable means of delivering large flux densities to solid surfaces, where the resulting thermal energy can cause phase changes, atomic migrations, and chemical reactions on a surface without greatly perturbing the bulk properties; alternatively, the photons may directly interact with species on the surface. These changes may result in improved properties of the materials by making the surface harder, more resistant to corrosion or wear, thermally resistant, or with lower coefficients of friction. In a solar furnace, this flux can be delivered in large quantities over large areas, or it can be tailored to match the demands of a particular process. Furthermore, this occurs without the environmental liability associated with providing power to more conventional light sources. Recent work at SERI has used fluxes in the range from 100 to 250 w/sq cm for inducing such beneficial surface transformations. Significant results have been obtained in the area of phase transformation hardening of steels and melting powders and preapplied coatings to form fully dense, well-bonded coatings on the surface. New directions in coating technology using highly concentrated solar beams to induce chemical vapor deposition processes are described. Application areas that have not been researched in detail but would appear to be good matches to the solar technology are also reviewed. Author

N92-14464# Sandia National Labs., Albuquerque, NM.
A COMPARISON OF THE ECONOMICS OF MATERIALS PROCESSING WITH SOLAR FURNACES AND HIGH-INTENSITY ARC LAMPS
Gregory J. Kolb *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 84-96 (For primary document see N92-14445 05-44)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC/MF A08

The cost and performance of treating materials with a solar furnace were compared to similar treatment with high-intensity electric-arc lamps. Qualitative results indicate that because of the long focal length of the solar furnace, it is capable of performing much dirtier materials processing tasks than the arc lamp. Quantitative results indicate that if the furnace is located in a good solar region, the solar furnace can beat the economics of the lamp by as much as a factor of three under certain operating scenarios. In other scenarios, the lamp is more cost effective.

The scenario that appears most promising for the furnace is batch processing that employs flux levels near 500 W/sq cm or greater. At lower flux levels, or in assembly-line-type processing tasks, the arc lamp is preferred. Author

N92-14465# Lawrence Livermore National Lab., CA.
SOLAR PUMPING OF LASERS **c36**
Lloyd Chase *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 97-98 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The fourth session of the workshop on Applications of Concentrated Solar Energy is summarized and an assessment of solar pumped laser technology is presented. The summarized papers addressed three different methods for concentrating solar flux to facilitate pumping of various laser materials. These methods included imaging concentrators, nonimaging concentrators, and blackbody cavity pumping. M.G.

N92-14466# Chicago Univ., IL. Dept. of Physics.
SOLAR PUMPED LASERS: WORK IN PROGRESS AT THE UNIVERSITY OF CHICAGO
Roland Winston *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 99-102 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Of the variety of solar energy conversion schemes that have been explored, the conversion of solar flux to coherent laser radiation is relatively new. Solar flux at sufficiently high concentrations to overcome threshold for the really important laser materials has not been available. This technological inhibition has recently been overcome through the application of nonimaging optics through the demonstration of concentration levels of 84,000 suns at the University of Chicago in a refractive medium (sapphire) and of over 20,000 suns in air at the Solar Energy Research Institute High Flux Facility. A thermodynamic overview is presented of solar lasers including solid state lasers and dye lasers. Author

N92-14467# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
BLACKBODY PUMPED LASERS **c36**
Walter H. Christiansen *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 103-105 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Solar pumping of lasers using line or band absorption is inefficient because of poor use of the optical spectrum. A different concept for a solar powered laser is presented which uses an intermediate blackbody cavity to provide a uniform optical pumping environment for the lasant, typically CO or CO2 or possibly a solid state laser medium. In such a system, the entire solar flux could be used to pump the lasant. Focused sunlight is used to heat a blackbody cavity. The cooled laser medium is positioned inside the cavity and pumped by the blackbody radiation. The concept can also apply to a solid medium. The blackbody radiation cycle is shown: the blackbody radiation emitted by the walls impinges on the laser medium; the medium absorbs a band of the spectrum, which results in the nonequilibrium spectrum; and this radiation is then reabsorbed and thermalized by the walls and reemitted in the original spectral distribution. In this way, the pumping radiation is continuously replenished and all the energy of the source is used to pump the laser absorption bands. The intermediate blackbody can be heated by solar radiation to a high temperature and its heat losses can be designed to be small. High power continuous wave blackbody pumped lasers with efficiencies on the order of 20 pct. or more are feasible, provided transparent optical materials are available and lasing threshold is reached. The feasibility of using intermediate blackbody cavity pumping was demonstrated with a CO2 laser. Author

N92-14468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SOLAR PUMPED LASERS AND THEIR APPLICATIONS **c36**
Ja H. Lee *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 106-107 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08 CSCL 20E

Since 1980, NASA has been pursuing high power solar lasers as part of the space power beaming program. Materials in liquid, solid, and gas phases have been evaluated against the requirements for solar pumping. Two basic characteristics of solar insolation, namely its diffuse irradiance and 5800 K blackbody-like spectrum, impose rather stringent requirements for laser excitation. However, meeting these requirements is not insurmountable as solar thermal energy technology has progressed today, and taking advantage of solar pumping lasers is becoming increasingly attractive. The high density photons of concentrated solar energy have been used for mainly electric power generation and thermal processing of materials by the DOE Solar Thermal Technologies Program. However, the photons can interact with materials through many other direct kinetic paths, and applications of the concentrated photons could be extended to processes requiring photolysis, photosynthesis, and photoexcitation. The use of solar pumped lasers on Earth seems constrained by economics and sociopolitics. Therefore, prospective applications may be limited to those that require use of quantum effects and coherency of the laser in order to generate extremely high value products and services when conventional and inexpensive means are ineffective or impossible. The new applications already proposed for concentrated solar photons, such as destruction of hazardous waste, production of renewable fuel, production of fertilizer, and air/water pollution controls, may benefit from the use of inexpensive solar pumped laser matched with the photochemical kinetics of these processes. Author

N92-14469# Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Central Research and Development Experimental Stations.
PHOTOCHEMICAL SYNTHESIS
David F. Eaton *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 109-112 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The current status of research is assessed, and potential applications are identified for, the use of concentrated solar photons in photochemical synthesis. Research directions are recommended which could lead to other applications. Opportunities do exist for application of concentrated solar photons in synthetic chemistry, but they are limited and they are not readily apparent. Greater opportunity probably exists in preparation of inorganic materials than organic ones, especially for refractory particles. Specialized purification processes are also potential areas for application. For one-sun level irradiation, biomass conversions may present opportunities. The most probable area for potential application is in materials processing. All of these areas are premature for application. Much research is required to understand the processes which can occur under high solar fluences before firm prediction of applications can be made. Author

N92-14470# Midwest Research Inst., Golden, CO. Photoconversion Research Branch.
PHOTOPHYSICS AND PHOTOCHEMISTRY OF PORPHYRIN SYSTEMS
John S. Connolly *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 113-115 Sponsored by DOE (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

Some fundamental aspects are addressed of photoinduced electron transfer and charge transfer in molecular systems leading to the design and assembly of a synthetic photoreaction center. Current studies are concerned with tightly linked porphyrin-quinone molecules in which strong electronic coupling between the donor and acceptor moieties is highly sensitive to small changes in the dielectric properties of the host matrix. This permits the probing

of the local dielectric environments in various media, including natural and synthetic polymers. Some new molecular systems were synthesized to study the effects of distance, extended conjugation, and energetics on the rates of intramolecular electron and charge transfer, and the influence of substituents on conformational rigidity of the porphyrin ring. Author

N92-14471# Allied-Signal Corp., Morristown, NJ. Research and Technology Div.

POTENTIAL INDUSTRIAL APPLICATIONS OF PHOTONS

James T. Yardley *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 116 (For primary document see N92-14445 05-44)

Avail: NTIS HC/MF A08

Photons provide unique opportunity for chemical processing: a fact which has received new significance with the development of laser technology. The maturity of solar energy control and management may open up even more unique and exciting opportunity areas. A tutorial view is presented of photochemical and photothermal processing. Some of the experiences are examined of scientists seeking to exploit the opportunities for lasers in chemical processing. Some economic factors are presented which place severe limitations on the practical utility for lasers in photochemical synthesis. Some of the technical factors which have limited the use of lasers for chemical processing are also explored. Some opportunities are discussed for solar photochemical processing. Author

N92-14472# California Univ., Berkeley. Lawrence Berkeley Lab.

FUEL PROCESSING AND THERMOCHEMICAL/PHOTOCHEMICAL CYCLES

Arlon J. Hunt *In* NAS-NRC Potential Applications of Concentrated Solar Energy 1991 p 117-120 (For primary document see N92-14445 05-44)

Avail: NTIS HC/MF A08

A long sought goal of energy research has been to find a method to produce hydrogen fuel economically by splitting water using sunlight as the source of energy. Implementing method of producing useful fuels from raw materials using sunlight on a large scale generally involves significant capital and energy costs. Sunlight is an attractive means of providing a renewable source of energy to drive the process after providing the initial capital outlay. However, the combination of capital costs to provide concentrated solar energy and the elaborate and expensive plants required to carry out the chemical processes puts a heavy financial burden on this approach to a clean and renewable energy economy. Solar driven fuel processing methods include thermal decomposition, thermochemical, photochemical, electrochemical, biochemical, and hybrid reactions. The range of approaches to carry out these processes runs the gamut from well established chemical engineering practices with near term predictable costs, to long term basic photochemical processes, the details of which are still speculative. Author

N92-14473# Gas Research Inst., Chicago, IL.

GAS RESEARCH INSTITUTE EXPERIENCE IN SOLAR FUEL RESEARCH

Kevin Krist *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 121-123 (For primary document see N92-14445 05-44)

Avail: NTIS HC/MF A08

Between 1981-1989, the Gas Research Institute (GRI) conducted a fundamental research program aimed at low-cost conversion of inorganic materials to gaseous fuels, using solar energy. Although the program focussed on photochemical approaches, thermochemical pathways were also evaluated. General conclusions are presented in the following areas: photochemical fuel synthesis, thermochemical fuel synthesis, photochemical processes, thermal processes, and collector systems. Author

N92-14474# Ecole Polytechnique, Montreal (Quebec). Dept. of Mechanical Engineering.

THERMAL, THERMOCHEMICAL, AND HYBRID SOLAR HYDROGEN PRODUCTION c25

Ertugrul Bilgen *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 125-128 Sponsored by Natural Sciences and Engineering Research Council (For primary document see N92-14445 05-44)

Avail: NTIS HC/MF A08

Various types of processes using thermal, thermochemical, and hybrid solar hydrogen production methods are reviewed. Basic process evaluation techniques are presented and discussed. Process efficiency and solar hydrogen costs are presented. Author

N92-14475# Weizmann Inst. of Science, Rehovoth (Israel). Center for Energy Research.

CHEMICAL REACTIONS DRIVEN BY CONCENTRATED SOLAR ENERGY

Moshe Levy *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 129-131 (For primary document see N92-14445 05-44)

Avail: NTIS HC/MF A08

Solar energy can be used for driving endothermic reactions, either photochemically or thermally. The fraction of the solar spectrum that can be photochemically active is quite small. Therefore, it is desirable to be able to combine photochemical and thermal processes in order to increase the overall efficiency. Two thermally driven reactions are being studied: oil shale gasification and methane reforming. In both cases, the major part of the work was done in opaque metal reactors where photochemical reactions cannot take place. We then proceeded working in transparent quartz reactors. The results are preliminary, but they seem to indicate that there may be some photochemical enhancement. The experimental solar facilities used for this work include the 30 kW Schaeffer Solar Furnace and the 3 MW Solar Central Receiver in operation at the Weizmann Institute. The furnace consists of a 96 sq. m flat heliostat, that follows the sun by computer control. It reflects the solar radiation onto a spherical concentrator, 7.3 m in diameter, with a rim angle of 65 degrees. The furnace was characterized by radiometric and calorimetric measurements to show a solar concentration ratio of over 10,000 suns. The central receiver consists of 64 concave heliostats, 54 sq. m each, arranged in a north field and facing a 52 m high tower. The tower has five target levels that can be used simultaneously. The experiments with the shale gasification were carried out at the lowest level, 20 m above ground, which has the lowest solar efficiency and is assigned for low power experiments. We used secondary concentrators to boost the solar flux. Author

N92-14476# Midwest Research Inst., Golden, CO. Center for Energy Research.

INEXPENSIVE PHENOL REPLACEMENTS FROM BIOMASS: AN ON-GOING TECHNOLOGY TRANSFER EFFORT

Helena L. Chum *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 132-136 Sponsored by DOE (For primary document see N92-14445 05-44)

Avail: NTiS HC/MF A08

The activities of the Chemical Conversion Research Branch of the United States Department of Energy (DOE) Solar Energy Research Institute (SERI) include the production of fuels, chemicals, and materials from renewable resources and wastes. The collaboration of DOE/Office of Industrial Materials Research Consortium (PMRC) is described. This collaboration is based on the conversion of waste wood and bark into an inexpensive phenolic and neutrals (P/N) product through fast pyrolysis and fractionation. The product replaces a substantial fraction of phenol in phenol-formaldehyde thermosetting resins. The technology transfer mechanism is highlighted. Author

N92-14477# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.
THE BIOTECHNOLOGY OF CULTIVATING DUNALIELLA RICH IN BETA CAROTENE: FROM BASIC RESEARCH TO INDUSTRIAL PRODUCTION **c51**
Mordhay Avron *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 138-139 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The unicellular alga Dunaliella exists in several ill-defined species. In hypersaline lakes, the Dunaliella strain which predominates is often red, rather than green, in color, due to massive accumulation of a single pigment, beta-carotene. Of the many strains of the genus Dunaliella described, only two strains, Dunaliella bardawil and Dunaliella salina Teod., have been shown to possess the capacity to produce large amounts of beta-carotene, when cultivated under appropriate conditions. Intensive cultivation of Dunaliella may be the first commercially successful example of the use of selected algae for the biological conversion of solar energy into products of commercial interest. This approach has so far been hampered by the economic difficulties inherent in the production of a sophisticated technology. The high-priced product, beta-carotene, accounts for the renewed interest in algal cultivation. After extraction of the beta-carotene from the concentrated Dunaliella, there remains a glycerol and protein-rich algae meal, which was shown to serve as an excellent source of feed for fish, fowl, and rats. Thus, we have in the Dunaliella cultivation system the aquaculturist's and ecologist's ideal facility: a production unit which removes CO2 from the air; produces oxygen, useful chemical products, and feed; and leaves no polluting residue requiring disposal. Author

N92-14478# Midwest Research Inst., Golden, CO. Biotechnology Research Branch.
PRODUCTION POTENTIAL OF BIOCHEMICALS FROM ALGAE AND OTHER BIOTECHNOLOGICAL INNOVATIONS ENABLED BY HIGHER SOLAR CONCENTRATION **c51**
Lewis M. Brown *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 140 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

The approach of using multiple-sun light intensity to increase the yield of various products from autotrophically grown algae is relatively unexplored. There are some possibilities for advanced photobioreactor design that might result in increased culture density and hence lower culture volume. However, culture productivity and product yield do not increase linearly with light intensity, but rather saturate a fairly low light intensities for most algae in the range of 15-20 percent of full sun depending on species and on growth irradiance. Instantaneous measurements of photosynthesis indicate that algae grown under higher light intensities are saturated at higher photosynthetic rates than algae grown under lower light intensities. There is no obvious advantage to growing algae at full sun let alone multiple suns because no increase in productivity is typically realized. However, it may be possible to grow algae in more concentrated culture at multiple-sun irradiances if smaller culture volumes are desired. Other aspects of this research are discussed. Author

N92-14479# Paul Scherrer Inst., Villigen (Switzerland).
STATUS OF EUROPEAN RESEARCH AND DEVELOPMENT IN SOLAR CHEMISTRY AND INDUSTRIAL INTEREST IN THIS TECHNOLOGY
Paul Kesselring *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 141-143 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

A short, noncomprehensive summary of the European situation is given and some technical aspects of the European research and development (R&D) activities are sketched. In conclusion, the long-term prospects for solar chemistry are considered to be good, which justifies an increased R&D effort. The expectations of short-term, strong impact applications, however, should not be boosted. Author

N92-14480*# Sverdrup Technology, Inc., Brook Park, OH.
ANALYSIS OF LUNAR REGOLITH THERMAL ENERGY STORAGE Final Report
Anthony J. Colozza Nov. 1991 9 p Proposed for presentation at the International Solar Energy Conference, Lahaina, HI; sponsored by ASME
(Contract NAS3-25266)
(NASA-CR-189073; E-6680; NAS 1.26:189073) Avail: NTIS HC/MF A02 CSCL 10C

The concept of using lunar regolith as a thermal energy storage medium was evaluated. The concept was examined by mathematically modeling the absorption and transfer of heat by the lunar regolith. Regolith thermal and physical properties were established through various sources as functions of temperature. Two cases were considered: a semi-infinite, constant temperature, cylindrical heat source embedded in a continuum of lunar regolith and a spherically shaped molten zone of lunar regolith set with an initial temperature profile. The cylindrical analysis was performed in order to examine the amount of energy which can be stored in the regolith during the day. At night, the cylinder acted as a perfect insulator. This cycling was performed until a steady state situation was reached in the surrounding regolith. It was determined that a cycling steady state occurs after approximately 15 day/night cycles. Results were obtained for cylinders of various diameters. The spherical molten zone analysis was performed to establish the amount of thermal energy, within the regolith, necessary to maintain some molten material throughout a nighttime period. This surrounding temperature profile was modeled after the cycling steady state temperature profile established by the cylindrical analysis. It was determined that a molten sphere diameter of 4.76 m is needed to maintain a core temperature near the low end of the melting temperature range throughout one nighttime period. Author

N92-14481 Midwest Research Inst., Golden, CO.
SOLAR THERMAL ENERGY CONTRACT LIST, FISCAL YEAR 1990
Sep. 1991 9 p
(Contract DE-AC02-83CH-10093)
(DE91-002175; DOE/CH-10093/98) Avail: NTIS HC/MF A02

The Federal government has conducted the National Solar Thermal Technology Program since 1975. Its purpose is to provide focus, direction, and funding for the development of solar thermal technology as an energy option for the United States. This year's document is more concise than the summaries of previous years. The FY 1990 contract overview comprises a list of all subcontracts begun, ongoing, or completed during FY 1990 (October 1, 1989, through September 30, 1990). Under each managing laboratory, projects are listed alphabetically by project area and then by subcontractor name. Amount of funding milestones are listed. DOE

N92-14482# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
PROCEEDINGS OF THE 15TH DOE SOLAR PHOTOCHEMISTRY RESEARCH CONFERENCE
1991 243 p Conference held in Snowmass, CO, 2-6 Jun. 1991
(Contract DE-AC02-83CH-10093)
(DE91-015008; SERI/CP-2360-4494; CONF-9106213) Avail: NTIS HC/MF A11

The annual Solar Photochemistry Research Conference brings together contractors and grantees of the Division of Chemical Sciences engaged in fundamental research on solar photochemical energy conversion to exchange information on recently completed studies, research in progress, and future plans. The meeting also provided an opportunity for interested representatives of government and industry to assess the current status of the field. The program encompassed the themes of photoelectrochemistry, organic and inorganic photochemistry, supramolecular assemblies,

solvent effects on electron transfer, and photosynthesis. This year, in an effort to provide an overview on solar photochemical energy conversion to new participants and to foster a cohesive approach in problem solving, a panel discussion was added, in which the panelists addressed the current status of the field and identified propitious pathways in solar photochemistry. DOE

N92-14483# WG Associates, Dallas, TX.
DESIGN OF THE SUPPORT STRUCTURE, DRIVE PEDESTAL, AND CONTROLS FOR A SOLAR CONCENTRATOR
V. R. Goldberg, J. L. Ford, and A. E. Anderson Aug. 1991 114 p Prepared for Sandia National Labs., Albuquerque, NM
(Contract DE-AC04-76DP-00789)
(DE92-000604; SAND-91-7007) Avail: NTIS HC/MF A06

The glass/metal McDonnell-Douglas dish is the state-of-the-art of parabolic dish concentrators. Because of the perceived high production cost of this concentrator, the Department of Energy's Solar Thermal Program is developing stretch membrane technology for large (75 kWt) solar concentrators for integration with receivers and engines in 25 kWe dish-Stirling systems. The objective of this development effort is to reduce the cost of the concentrator while maintaining the high levels of performance characteristic of glass-metal dishes. Under contract to Sandia National Laboratories, Science Applications International Corporation, Solar Kinetics Inc. and WG Associates are developing a faceted stretched-membrane heliostat technology. This design will result in a low-risk, near-term concentrator for dish-Stirling systems. WG Associates has designed the support structure, drives and tracking controls for this dish. The structure is configured to support 12 stretched-membrane, 3.5-meter diameter facets in a shaped dish configuration. The dish design is sized to power a dish-Stirling system capable of producing 25 kW (electric). In the design of the structure, trade-off studies were conducted to determine the best facet arrangement, dish contour, dish focal length, tracking control and walk-off protection. As part of the design, in-depth analyses were performed to evaluate pointing accuracy, compliance with AISC steel design codes, and the economics of fabrication and installation. Detailed fabrication and installation drawings were produced, and initial production cost estimates for the dish were developed. These issues, and the final dish design, are presented in this report. DOE

N92-14484# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
PHOTOVOLTAIC FUNDAMENTALS
P. Pitchford, ed., J. Jones, ed., and B. Glenn, ed. Sep. 1991 63 p
(Contract DE-AC02-83CH-10093)
(DE91-015001; DOE/CH-10093/117; SERI/TP-220-3957) Avail: NTIS HC/MF A04

This booklet describes how photovoltaic (PV) devices and systems work. It also describes the specific materials and devices that are most widely used commercially as of 1990 and those that have the brightest prospects. Students, engineers, scientists, and others needing an introduction to basic PV technology, and manufacturers and consumers who want more information about PV systems should find this booklet helpful. We begin with an overview and then explain the rudimentary physical process of the technology, the photovoltaic effect. Next, we consider how scientists and engineers have harnessed this process to generate electricity in silicon solar cells, thin-film devices, and high-efficiency cells. We then look at how these devices are incorporated into modules, arrays, and power-producing systems. We have written and designed this book so that the reader may approach the subject on three different levels. First, for the person who is in a hurry or needs a very cursory overview, in the margins of each page we generalize the important points of that page. Second, for a somewhat deeper understanding, we have provided ample illustrations, photographs, and captions. And third, for a thorough introduction to the subject, the reader can resort to reading the text. DOE

N92-14485*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMOCHEMICAL ENERGY STORAGE FOR A LUNAR BASE
Marla E. Perez-Davis, Barbara I. McKissock, and Frank DiFilippo (Case Western Reserve Univ., Cleveland, OH.) 1992 7 p Proposed for presentation at the International Solar Energy Conference, Lahaina, Maui, HI, 4-8 Apr. 1992; sponsored by ASME
(NASA-TM-105333; E-6700; NAS 1.15:105333) Avail: NTIS HC/MF A02 CSCL 10B

A thermochemical solar energy storage concept involving the reversible reaction CaO + H2O yields Ca(OH)2 is proposed as a power system element for a lunar base. The operation and components of such a system are described. The CaO/H2O system is capable of generating electric power during both the day and night. Mass of the required amount of CaO is neglected since it is obtained from lunar soil. Potential technical problems, such as reactor design and lunar soil processing, are reviewed. Author

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-14486# International Centre for Theoretical Physics, Trieste (Italy).
ON THE THEORY OF POLAR OZONE HOLES
E. C. Njau Dec. 1990 14 p
(DE91-635165; IC-90/393) Avail: NTIS HC/MF A03

The viable theories already proposed to explain polar ozone holes generally fall into two main categories, namely, chemical theories and dynamical theories. In both of these categories, polar stratospheric clouds (PSCs) are taken as part of the essential basis. Besides, all the dynamical theories are based upon temperature changes. Since formation of the PSCs is highly temperature-dependent, it has been concluded from recent research (e.g., Kawahira and Hirooka) that temperature changes are a cause, not a result of ozone depletion in polar regions. On this basis, formulations are developed that represent short-term and long-term temperature variations in the polar regions due to natural processes. These variations, which are confined to a limited area around each pole, include specific oscillations with periods ranging from approximately 2 years up to approximately 218,597 years. Polar ozone variations are normally expected to be influenced by these temperature oscillations. It is, therefore, apparent that the generally decreasing trend observed in mean October ozone column at Halley Bay (76 deg. S, 27 deg. W) from 1956 up to 1987 is mostly caused by the decreasing phase of a combination of two natural temperature oscillations, one with a period of approximately 70-80 years and the other with a period of approximately 160-180 years. Contributions of other natural temperature oscillations are also mentioned and briefly discussed. DOE

N92-14487# State Univ. of New York, Albany.
MAINTENANCE OF A RURAL PRECIPITATION CHEMISTRY CENTER AT WHITEFACE MOUNTAIN
V. A. Mohnen 1 Sep. 1991 17 p
(Contract DE-FG02-84ER-60227)
(DE92-000033; DOE/ER-60227/6) Avail: NTIS HC/MF A03

For the Past 11 years, Whiteface Mountain (WFM) has been successfully collecting data according to the MAP3S (Multistate Power Production Pollution Study) protocols. These protocols include field sampling, laboratory procedures, sample handling and shipment, and supporting measurements at the summit or lodge including meteorological and air quality parameters. All blind tests and audits have been successfully passed. Since the beginning of the MAP3S program it was recognized that, because of its remoteness, WFM needed some additional support to process the samples and to obtain site specific supporting data. The primary purpose of this funding was to insure the technical support to maintain the availability of WFM so that the necessary high quality

research monitoring could continue. In addition, during the past year, we were able to: (1) perform all operations required by the National Trends Network (NTN) precipitation monitoring network: (2) begin the comparison of MAP3S data with similar data taken at WFM; (3) begin a series of ion chromatography measurements on MAP3S duplicate samples (when sufficient volume was available) to study the effect of time delays between sample collection and chemical analysis; (4) provide wet deposition data to the EPA Mountain Cloud Chemistry Program (MCCP); (5) assess the precipitation data quality of the ENSR measurements collocated with MAP3S. Selected results are presented. DOE

N92-14488# Lawrence Livermore National Lab., CA.
STATISTICAL CHARACTER OF TOXIC METAL CONCENTRATIONS IN SOIL SAMPLES CONTAMINATED BY ATMOSPHERIC DEPOSITION: IMPLICATIONS FOR COMPLIANCE
J. H. Shinn and F. J. Gouveia May 1991 11 p Presented at the 84th Annual Meeting and Exhibition of the Air and Waste Management Association, (AWMA), Vancouver, British Columbia, 16-21 Jun. 1991
(Contract W-7405-eng-48)
(DE91-018467; UCRL-JC-106334; CONF-910659-33) Avail: NTIS HC/MF A03

The requirements of recent regulations for airborne toxic substances are sometimes interpreted to mean an assessment of the fate and environmental effects of metal particles deposited on the landscape by atmospheric processes. This paper examines the problems of sampling soil for deposited metals. The statistical character of contaminants in soil is not well understood by the administrators of environmental compliance, nor by persons responsible for soil sampling. Fortunately, there have been sufficient studies of metal concentrations in soil contaminated by atmospheric deposition that some generalizations can be drawn. Here we show some practical results that will aid in answering many questions about soil sampling such as: How many samples are required to estimate the central tendency (mean or median)? How large should an analyzed aliquot be to assure reproducible results? How many samples in a population will be out of compliance when the mean or median is well within compliance? When remedial action is taken, how clean is clean? DOE

N92-14489# Argonne National Lab., IL.
REGIONAL ANALYSIS OF S EMISSION-DEPOSITION TRENDS IN NORTH AMERICA FROM 1979 THROUGH 1988
J. D. Shannon 1991 8 p Presented at the 19th Information Transfer Meeting (ITM) on Air Pollution Modelling and Its Applicatin, Crete, Greece, 29 Sep. - 4 Oct. 1991
(Contract W-31-109-eng-38)
(DE91-018545; ANL/CP-73968; CONF-9109258-1) Avail: NTIS HC/MF A02

Variations in SO(x) emissions weighted by a regional deposition model are shown to account for most of the variance in regionally averaged annual wet deposition (WD) and precipitation weighted concentrations (PWCs) of sulfate in the U.S. and Canada during the period 1979 to 1988. Total emissions decreased about 15 pct. during that time. For all sites combined, weighted emissions accounted for about two-thirds of the variance, with slightly better performance for PWC than for WD. Restricting the emission regions to the states containing the monitoring sites in each region led to very mixed results, with good explanation of WD and PWC variance in the Midwest and in all sites combined but generally poor explanation elsewhere, particularly for WD. In some regions, local emission densities are quite low, and most deposition would be expected to result from outside sources, so no strong relationship between local emission rates and deposition would be expected. Including annual meteorological variability in the emission weighting improved variance explanation in several of the peripheral regions, but reduced variance explanation elsewhere, particularly in the Midwest, the region of the highest emission density. DOE

N92-14490*# McDonnell-Douglas Space Systems Co., Seabrook,MD.
NEED FOR EXPANDED ENVIRONMENTAL MEASUREMENT CAPABILITIES IN GEOSYNCHRONOUS EARTH ORBIT
Enrico P. Mercanti 1991 11 p
(Contract NAS5-30363)
(NASA-CR-183487; NAS 1.26:183487) Avail: NTIS HC/MF A03 CSCL 13B

The proliferation of environmental satellites in low altitude earth orbit (LEO) has demonstrated the usefulness of earth remote sensing from space. As use of the technology grows, the limitations of LEO missions become more apparent. Many inadequacies can be met by remote sensing from geosynchronous earth orbits (GEO) that can provide high temporal resolution, consistent viewing of specific earth targets, long sensing dwell times with varying sun angles, stereoscopic coverage, and correlative measurements with ground and LEO observations. An environmental platform in GEO is being studied by NASA. Small research satellite missions in GEO were studied (1990) at GSFC. Some recent independent assessments of NASA Earth Science Programs recommend accelerating the earlier deployment of smaller missions. Author

N92-14491# Argonne National Lab., IL.
THE CARBON ISOTOPIC COMPOSITION OF ATMOSPHERIC METHANE AND ITS SOURCES AND TRENDS; DISTRIBUTION OF SOURCE FLUXES AND THEIR CONTRIBUTION TO THE INCREASING CONCENTRATION
C. M. Stevens 1991 23 p Presented at the North Atlantic Treaty Organization (NATO) Advanced Research Workshop, Mount Hood, OR, 6-11 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-000268; ANL/CP-74364; CONF-9110220-1) Avail: NTIS HC/MF A03

The goal of isotopic studies of atmospheric methane is the determination of the relative fluxes of the various sources of different isotopic composition. Because of the large number of generic anthropogenic source types, it is not possible to determine their relative strengths based on carbon-13 data alone. However, by combining sources of similar isotopic composition (as well as similar origin), and utilizing results from other studies, it is possible to calculate some important features of the atmospheric CH4 cycle. The C-13/C12 ratio of atmospheric CH4 is increasing in both the Southern and Northern Hemisphere with a faster rate in the former. Analysis of these results shows that the increasing fluxes of CH4 from biomass burning in the Southern Hemisphere contribute about 60 percent of the rate of increasing concentration. In the past decade the trend in the Northern Hemisphere can be interpreted as caused by both increasing and decreasing fluxes from the natural wetlands sources. DOE

N92-14492# Pacific Northwest Lab., Richland, WA.
INFLUENCES OF CLOUDS AND RAIN ON THE LARGE-SCALE TRANSPORT AND DEPOSITION OF SULFUR
D. J. Luecken, C. M. Berkowitz, and R. C. Easter Jul. 1991 13 p Presented at the 5th International Conference on Precipitation Scavenging and Atmosphere Surface Exchange Process, Richland, WA, 15-19 Jul. 1991
(Contract DE-AC06-76RL-01830)
(DE92-000473; PNL-SA-20020; CONF-9107104-16) Avail: NTIS HC/MF A03

This paper describes the application of a three-dimensional, global-scale Eulerian model with an explicit description of cloud and chemical processes. Simulation results describing the transport of sulfur from North America and Europe across the North Atlantic Ocean during a climatological July are presented. Wet deposition was found to contribute slightly more to total sulfur deposition than dry deposition, a feature explained by the large amounts of precipitation during this month. The wet deposition patterns did not always correspond to the emissions patterns. The precipitation rate and spatial distribution had a large effect on the calculated concentrations of soluble sulfur species. DOE

N92-14493# Wisconsin Univ., Madison. Space Science and Engineering Center.
HIGH SPECTRAL RESOLUTION MEASUREMENTS FOR THE ARM PROGRAM
H. E. Revercomb 15 Mar. 1991 7 p
(Contract DE-FG02-90ER-61057)
(DE92-000765; DOE/ER-61057/1) Avail: NTIS HC/MF A02

The University of Wisconsin teamed with the University of Denver for the design and fabrication of high-spectral resolution FTIR (Fourier Transform Infrared) instrumentation for the CART sites of the Atmospheric Radiation Measurement (ARM) Program that began on September 15, 1990. This year-one report summarizes progress from the start date to March 15, 1991. The project is currently on schedule to achieve the primary objectives of the first year. The ultimate objective of this grant is to develop three different types of instruments, named the AERI, AERI-X, and SORTI. The Atmospheric Emitted Radiance Interferometer (AERI) is the simplest. It will be available for early deployment at the first ARM site and will be deployable at several locations in the extended network to give horizontal coverage. The AERI will be an 0.5 cm(exp -1) resolution (unapodized) instrument, which measures accurately calibrated radiance spectra for radiation studies and for remote sensing of atmospheric state variables. It would also be feasible to design an AERI for an aircraft or tethered balloon platform, although this is not a part of the current grant. The AERI-X and the SORTI are higher spectral resolution instruments for obtaining the highest practical resolution for spectroscopy at the ARM central sites. The AERI-X, like the AERI, will measure atmospheric emitted radiance, but with resolutions as high as 0.1 cm(exp -)1. The Solar Radiance Transmission Interferometer (SORTI) will measure the total transmission of the atmosphere by tracking the sun as the atmospheric air mass changes. The large solar signal makes it practical for this instrument to offer the ultimate in spectral resolution, 0.002 cm(exp -1).

DOE

N92-14494# California Univ., Berkeley. Lawrence Berkeley Lab.
OPTIONS FOR REDUCING CARBON DIOXIDE EMISSIONS
A. H. Rosenfeld and L. Price Aug. 1991 31 p Presented at the Spring Meeting of the American Physical Society (APS), Washington, DC, 15-18 Apr. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000906; LBL-31177; CONF-910427-4) Avail: NTIS HC/MF A03

Improvements in energy efficiency can significantly reduce the annual growth in greenhouse gas emissions. Such improvements occur when energy intensity is reduced; no reduction in energy services is required. Using the concept of cost of conserved energy to develop conservation supply curves similar to resource supply curves, researchers consistently find that electricity and natural gas savings of nearly 50 percent of current consumption are possible for US buildings. Such reductions in energy consumption directly reduce emissions of greenhouse gases. To capture these savings, we must continue to develop energy-efficient technologies and strategies. This paper describes three recent energy-efficient technologies that benefited from energy conservation research and development (R&D) funding: high-frequency ballasts, compact fluorescent lamps, and low-emissivity windows. Other advanced technologies and strategies of spectrally selective windows, superwindows, electrochromic windows, advanced insulation, low-flow showerheads, improved recessed lamp fixtures, whitening surfaces and planting urban trees, daylighting, and thermal energy storage are also discussed.

DOE

N92-14446# Environmental Protection Agency, Athens, GA. Environmental Research Lab.
WATER TREATMENT: ADVANCED PHOTOOXIDATION PROCESSES
Richard G. Zepp *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 1-5 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14447# North Carolina Univ., Chapel Hill. Dept. of Environmental Science and Engineering.
CHEMICAL MODELS OF ADVANCED OXIDATION PROCESSES
William H. Glaze *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 6-8 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14448# Midwest Research Inst., Golden, CO.
MECHANISTIC STUDIES OF THE PHOTOCATALYTIC BEHAVIOR OF TiO2 PARTICLES IN A PHOTOELECTROCHEMICAL SLURRY CELL AND THE RELEVANCE TO PHOTODETOXIFICATION REACTIONS
M. W. Peterson, J. A. Turner, and Arthur J. Nozik *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 9-15 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14449# Midwest Research Inst., Golden, CO.
EFFECT OF LIGHT INTENSITY ON PHOTOCATALYTIC REACTION
Craig S. Turchi *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 16-19 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14450# Illinois State Water Survey, Champaign.
A COMPARISON OF ADVANCED OXIDATION PROCESSES WITH SEMICONDUCTOR-CATALYZED PHOTO-OXIDATION
Gary R. Peyton *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 20-21 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14451# Ultrox International, Inc., Santa Ana, CA.
ULTROX OPERATING EXPERIENCES WITH UV/OXIDATION; ECONOMICS
Jack D. Zeff *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 22-24 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14452# Midwest Research Inst., Golden, CO.
SOLAR PHOTOCATALYZED PROCESS ECONOMICS
Hal Link *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 25-27 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14453# NuLite, London (Ontario).
PHOTOCATALYZED REMOVAL OF MULTIPLE CONTAMINANTS FROM WATER
Hussain Al-Ekabi *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 28-29 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14454# Midwest Research Inst., Golden, CO.
IMMOBILIZED CATALYSTS IN SOLAR CONCENTRATORS
Mark S. Mehos *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 30-31 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14455# Sandia National Labs., Albuquerque, NM. Solar Thermal Collector Technology Div.
PHOTOCATALYSIS WITH LARGE-SCALE TROUGH COLLECTORS
James E. Pacheco *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 32-33 (For primary

document see N92-14445 05-44)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC/MF A08

N92-14456# Pasternak (Alan D.), Lafayette, CA.
WASTE TREATMENT
Alan D. Pasternak *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 35-37 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14457# Dayton Univ., OH. Environmental Sciences Group.
HIGH-TEMPERATURE PHOTOCHEMISTRY INDUCED BY CONCENTRATED SOLAR RADIATION
Barry Dellinger, John Graham, Joel M. Berman, and Don Klosterman *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 38-47 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14458# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Kinetics Div.
CHEMICAL PROCESSES DURING INCINERATION AND IMPLICATIONS OF DETOXIFICATION OF HAZARDOUS WASTES USING SOLAR PHOTONS
Wing Tsang *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 48-50 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14459# Chemical Waste Management, Inc., Geneva, IL.
SOLAR TECHNOLOGY APPLICATIONS IN CHEMICAL WASTE MANAGEMENT
Peter S. Daley *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 51-57 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14460# Stanford Univ., CA. Dept. of Materials Science and Engineering.
MATERIALS PROCESSING AND SYNTHESIS
Bruce M. Clemens *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 59-63 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-14495 Utah State Univ., Logan.
A STUDY OF THE RELATIONSHIP BETWEEN IONOSPHERIC OSCILLATIONS AND GEOMAGNETIC PULSATIONS Ph.D. Thesis
Jann-Yenq Gim Liu 1988 127 p
Avail: Univ. Microfilms Order No. DA9120584

Numerous data obtained with a digital ionospheric sounder and a coincident magnetometer show that there is a strong correlation between the oscillations in the ionosphere and pulsations of the Earth's magnetic field at ground level. Many theoretical models have been developed to study the relationship between ionospheric oscillations and geomagnetic pulsations. In these models, pulsations of the Earth's magnetic field, advection of ionospheric plasma, divergence of ionospheric plasma, and photochemical processes in the ionosphere are considered to be four mechanisms which cause ionospheric oscillation and geomagnetic pulsations. However, the four mechanisms proposed in the earlier models are functions of ionospheric electric and geomagnetic fields, which cannot be directly applied to study the relationship between ionospheric oscillations and geomagnetic pulsations. An analytic relationship between ionospheric electric fluctuation field, ionospheric geomagnetic pulsation field, and the geomagnetic pulsation field at ground-level was derived by applying the theory of hydromagnetic waves. Based on this result, the earlier theoretical models can be extended and the relationship between ionospheric oscillations and geomagnetic pulsation field, and the geomagnetic pulsation field at ground-level is also obtained. The analytic results in this study show that: (1) the phase difference between the O- and X-mode Doppler velocity oscillations, due to the variations of the longitudinal component of the geomagnetic field, is 180 degrees; and (2) oscillations of the Doppler velocity lag and the lead pulsations of the northward component of the geomagnetic field at ground-level, due to the advection and divergence mechanisms, by 90 degrees. The phenomena mentioned above are also demonstrated by the numerical results presented in the earlier models. Dissert. Abstr.

N92-14496 Maryland Univ., College Park.
THE FLOW CONFIGURATION OF PROTONS AND ALPHA PARTICLES IN THE EARTH'S SUBSOLAR MAGNETOSHEATH Ph.D. Thesis
Emily Alice Greene 1990 192 p
Avail: Univ. Microfilms Order No. DA9121344

Attempts were made to experimentally determine whether the magnetosheath bulk flow has a stagnation point or a stagnation line configuration, using data from the Active Mesospheric Particle Tracer Explorer (AMPTE)/Charge Composition Explorer (CCE) Spacecraft. The AMPTE/CCE spacecraft has an equatorial orbit with an apogee of 8.8 R sub 3. During compressions of the magnetosphere, it enters the subsolar magnetosheath, sometimes for several hours. This is an ideal situation to observe the flow configuration because the spacecraft is at rest, or nearly so, in the subsolar region. The CHEM instrument can detect ions from 1 to 300 keV/e in approximately the YZ GSE plane, the plane parallel to the magnetopause. Near the subsolar region, most of the bulk flow speed is in this plane. The H(+) and He(+2) is approximately 20 percent lower than that of the H(+) on average, although this may be a computational artifact. The bulk flow direction was compared to the theoretical flow direction predictions for a stagnation point and a stagnation line. It was found that 36 percent of the time intervals were consistent with the theory of a stagnation point, while 24 percent of the intervals were consistent with the theory of a stagnation line. The hourly average interplanetary magnetic field from the IMP 8 spacecraft was examined during the orbits for which it was available. For orbits with a significant number (greater than 4) of stagnation point-like intervals, the interplanetary magnetic field (IMF) was either northward or unmeasured. In contrast, for stagnation line-like orbits the IMF was either southward or unmeasured. The flow configuration of the subsolar magnetosheath appears to be fundamentally different for different orientations of the IMF.
Dissert. Abstr.

N92-14497 Stanford Univ., CA.
FIRST COINCIDENCE EXPERIMENTS BETWEEN CRYOGENIC RESONANT-MASS GRAVITATIONAL WAVE DETECTORS, 1. DEVELOPMENT OF A THIN FILM SUPERCONDUCTING TRANSDUCER FOR A GRAVITATIONAL WAVE ANTENNA, 2 Ph.D. Thesis
Thomas Robert Stevenson 1991 265 p
Avail: Univ. Microfilms Order No. DA9122587

Two aspects of detecting gravitational radiation from astrophysical sources are examined. First, the data collection and analysis for a coincidence experiment using gravitational wave detectors are described. This experiment was important for several reasons: (1) it was the first coincidence experiment between cryogenic resonant mass detectors; (2) it improved the observational upper limit on the flux of impulsive gravitational waves that impinge upon the Earth; and (3) it lead to the development of a data analysis method for converting the experimental results into an astrophysical meaningful limit on the flux of gravitational radiation from impulsive events. Next, the development of a superconducting thin film motion transducer intended for use on

an ultralow temperature detector is described. To reach the sensitivity goal, the physical temperature of the detector will be lowered to 40 mK, a lower noise SQUID amplifier will be used, and a new motion transducer will be developed. The design and fabrication process are described. The experimental results obtained with the first prototype transducer are given.
Dissert. Abstr.

N92-14498 Edinburgh Univ. (Scotland).
THE STRATOSPHERIC RESIDUAL CIRCULATION AS DEDUCED FROM SATELLITE DATA Ph.D. Thesis
Stephen Reuben Beagley 1989 292 p
Avail: Univ. Microfilms Order No. BRD-92844

In 2-D modeling of the stratosphere, the residual circulation and the TEM equation re-formulation are put forward as a satisfactory analysis framework. Satellite data, principally from the LIMS and SSU instruments, is used to examine the residual circulation for the period Dec. 1978 to Nov. 1979. What drives the circulation and how the various components and forcing mechanisms vary through the seasons and between the hemispheres are investigated. In particular, the role of the eddy forcing, both time averaged and transient, in driving the residual circulation and in the momentum and heat budgets is examined. The residual circulation is examined in various forms. The eddy driven circulations were seen to be important components of the total residual circulations evaluated and provided necessary contributions in the budgets of momentum and heat. The magnitude of the principal eddy forcing term, D(sub f), is shown to be large during several months and so must result in vigorous mixing which for a complete description of the total transport must be parameterized when use of a residual circulation is made in modeling. A number of important variations in seasonal behavior and differences between hemispheres were observed which could have important consequences upon the transport of tracer quantities.
Dissert. Abstr.

N92-14499*# National Aeronautics and Space Administration, Washington, DC.
NASA UPPER ATMOSPHERE RESEARCH PROGRAM: RESEARCH SUMMARIES 1988-1989 Report to the Congress and the EPA
Jan. 1990 350 p
(NASA-TM-105120; NAS 1.15:105120) Avail: NTIS HC/MF A15 CSCL 04A

Given here is a report on the state of our knowledge of the Earth's upper atmosphere, particularly the stratosphere, and the NASA Upper Atmosphere Research Program. For individual titles, see N92-14500 through N92-14554.

N92-14500*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MEASUREMENT OF TRACE STRATOSPHERIC CONSTITUENTS WITH A BALLOON BORNE LASER RADAR
William S. Heaps and Thomas J. McGee *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 11 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective of this research was to measure the concentration of the stratospheric hydroxyl radical and related chemical species as a function of altitude, season, and time of day. Although hydroxyl plays a very important role in the chemistry controlling stratospheric ozone, little is known about its behavior because it has been a difficult species to measure. The instrument employed in this program was a laser radar, employing the technique of remote laser induced fluorescence. This instrument offers a number of attractive features including extreme specificity and sensitivity, a straightforward relationship between observed quantity and the desired concentration, and immunity to self-contamination.
Author

N92-14501*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INFRARED MEASUREMENTS OF ATMOSPHERIC CONSTITUENTS
David G. Murcray, Frank J. Murcray, Aaron Goldman, Curtis P. Rinsland, C. Camy-Peyret, and J. M. Flaud (Laboratoire de Physique Moleculaire et d'Optique Atmospherique, Orsay, France) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 25-26 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective of this program is to obtain data concerning the concentration versus altitude of various constituents of interest in the photochemistry of the stratospheric ozone layer. Data pertinent to this objective are obtained using balloon-borne instruments to measure the atmospheric transmission and emission in the mid infrared. In addition to obtaining constituent profile information, the spectral data obtained are also used to identify absorption or emission features which may interfere with the retrieval of constituent data from satellite instruments using lower spectral resolution. The spectral resolution obtained with the solar spectral system is 0.0025 cm(exp -1) and represents about a factor of 5 greater resolution than any solar spectra previously obtained in this spectral region. As a result of the increase in spectral resolution, a large number of features are observed in these spectra which were not observed in previous studies. Identification and analysis of these features is in progress. The results of this analysis to date shows a number of HNO3 features which have not been observed before, and these occur where they will interfere with the retrieval of other constituents. An example of the interference is the occurrence of features in the 780.2 cm(exp -1) region which overlap the ClONO2 feature which will be used for retrieval of ClONO2 by the CLAES instrument on UARS. A number of features due to COF2 were also identified in the 1250 cm(exp -1) region which may interfere with retrieval of N2O5.
Author

N92-14502*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THERMAL EMISSION SPECTROSCOPY OF THE MIDDLE ATMOSPHERE
V. G. Kunde, J. C. Brasunas, B. J. Conrath, J. R. Herman, W. C. Maguire, S. T. Massie, and Mian M. Abbas (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 27-28 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The general objective of this research is to obtain, via remote sensing, simultaneous measurements of the vertical distributions of stratospheric temperature, ozone, and trace constituents that participate in the catalytic destruction of ozone (NO(sub y): NO, NO2, NO3, HNO3, ClONO2, N2O5, HNO4; Cl(sub x): HOCl), and the source gases for the catalytic cycles (H2O, CH4, N2O, CF2Cl2, CFCl3, CCl4, CH3Cl, CHF2Cl, etc.). Data are collected during a complete diurnal cycle in order to test our present understanding of ozone chemistry and its associate catalytic cycles. The instrumentation employed is an emission-mode, balloon-borne, liquid-nitrogen-cooled Michelson interferometer-spectrometer (SIRIS), covering the mid-infrared range with a spectral resolution of 0.020 cm(exp -1). Cryogenic cooling combined with the use of extrinsic silicon photoconductor detectors allows the detection of weak emission features of stratospheric gaseous species. Vertical distributions of these species are inferred from scans of the thermal emission of the limb in a sequence of elevation angles. The fourth SIRIS balloon flight was carried out from Palestine, Texas on September 15-16, 1986 with 9 hours of nighttime data (40 km). High quality data with spectral resolution 0.022 cm(exp -1), were obtained for numerous limb sequences. Fifteen stratospheric species have been identified to date from this flight: five species from the NO(sub y) family (HNO3, NO2, NO, ClONO2, N2O5), plus CO2, O3, H2O, N2O, CH4, CCl3F, CCl2F2, CHF2Cl, CF4, and CCl4. The nighttime values of N2O5, ClONO2, and total odd nitrogen have been measured for the first time, and compared to

model results. Analysis of the diurnal variation of N2O5 within the 1984 and 1986 data sets, and of the 1984 ClONO2 measurements, were presented in the literature. The demonstrated ability of SIRIS to measure all the major NO(sub y) species, and therefore to determine the partitioning of the nitrogen family over a continuous diurnal cycle, is a powerful tool in the verification and improvement of photochemical modeling. Author

N92-14503*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FAR INFRARED BALLOON-BASED LIMB EMISSION MEASUREMENTS OF HO(SUB x) GASES IN THE MIDDLE ATMOSPHERE
James M. Russell, III, Bruno Carli, Ira G. Nolt, and Susan Solomon (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 31 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The aim of the measurements is to obtain vertical mixing of profiles of hydrogen and halogen trace gases and to study the related processes of diurnal change, OH/HO2 ratio, and HO sub x total budget involved in stratospheric ozone. The species to be measured in the first planned 1990 flight of this new series include OH, H2O2, HO2, HOCl, HBr, HCl, HF, H2O, HDO, O3, and isotopic O3. Recent analyses have been completed for the retrieval of the OH concentration profile and the first measurement of the HBr column concentration. Author

N92-14504*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MEASUREMENT OF THE SOLAR UV FLUX IN THE STRATOSPHERE
James E. Mentall *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 32 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Measurements of the direct solar flux from balloons at an altitude of 40 km are used to determine the effective cross sections of the Schumann-Runge bands. Transmission in these bands, which lie between 180 and 200 nm, allows the Sun's radiation in this region of the spectrum to penetrate into the lower mesosphere. Measurements by a high resolution scanning spectrometer (0.02 nm) are used to measure the transmission in the Schumann-Runge bands. Since ozone absorbs in this wavelength region, a low resolution scanning spectrometer (0.25 nm) measures the transmission between 220 and 260 nm, allowing the column ozone to be determined. Absorption due to ozone can then be calculated and the data corrected for this effect. Author

N92-14505*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
STRATOSPHERIC CONSTITUENT DISTRIBUTIONS FROM BALLOON-BASED LIMB THERMAL EMISSION MEASUREMENTS
Mian M. Abbas and Vigil G. Kunde (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 37-38 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

This research task deals with an analysis of infrared thermal emission observations of the Earth's atmosphere for determination of trace constituent distributions. Infrared limb thermal emission spectra in the 700-2000 cm(exp -1) region were obtained with a liquid nitrogen cooled Michelson interferometer-spectrometer (SIRIS) on a balloon flight launched from Palestine, Texas, at nighttime on September 15-16, 1986. An important objective of this work is to obtain simultaneously measured vertical mixing ratio profiles of O3, H2O, N2O, NO2, N2O5, HNO3 and ClONO2 and compare with measurements made with a variety of techniques by other groups as well as with photochemical model calculations. A portion of the observed spectra obtained by SIRIS from the balloon flight on September 15-16, 1986, has been analyzed with a focus on calculation of the total nighttime odd nitrogen budget from the simultaneously measured profiles of important members of the NO(sub x) family. The measurements permit first direct determination of the nighttime total odd nitrogen concentrations NO(sub y) and the partitioning of the important elements of the NO(sub x) family. Author

N92-14506*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COLLECTING, ANALYZING AND ARCHIVING OF GROUND BASED INFRARED SOLAR SPECTRA OBTAINED FROM SEVERAL LOCATIONS
David G. Murcray, Frank J. Murcray, Aaron Goldman, Charles T. McElroy, William P. Chu, Curtis P. Rinsland, Peter Woods, W. A. Matthews, and P. V. Johnston (Department of Scientific and Industrial Research, Lauder, New Zealand) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 45-46 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The infrared solar spectrum as observed from the ground under high resolution contains thousands of absorption lines. The majority of these lines are due to compounds that are present in the Earth's atmosphere. Ground based infrared solar spectra contain information concerning the composition of the atmosphere at the time the spectra were obtained. The objective of this program is to record solar spectra from various ground locations, and to analyze and archive these spectra. The analysis consists of determining, for as many of the absorption lines as possible, the molecular species responsible for the absorption, and to verify that current models of infrared transmission match the observed spectra. Archiving is an important part of the program, since a number of the features in the spectra have not been identified. At some later time, when the features are identified, it will be possible to determine the amount of that compound that was present in the atmosphere at the time the spectrum was taken. Author

N92-14507*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GROUND-BASED LIDAR MEASUREMENTS OF STRATOSPHERIC OZONE. THE NASA/GSFC STRATOSPHERIC OZONE LIDAR TRAILER EXPERIMENT STROZ LITE
Thomas J. McGee, James Butler (STX Corp., Hampton, VA.), John Burris, and William S. Heaps *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 57-58 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The major research objective is the measurement of high precision vertical profiles of ozone between 20-40 kilometers. The precision is such that the instrument should be capable of detecting a small trend (on the order of less that 1 percent per year) over a 5-10 year period. Temperature was measured between 30 and 365 km. The Goddard Space Flight Center (GSFC) mobile lidar was installed at Table Mountain and a comparison between it and the permanent Jet Propulsion Laboratory (JPL) lidar was made over the course of about 3 weeks. The lidars agreed very well between 20 and 40 km, and under certain conditions up to 45-47 km. There were several anomalies that both lidars followed very well. Agreement with Rocket Ozonesonde (ROCOZ) and electrochemical concentration cell (ECC) sondes was also very good. Author

N92-14508*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MILLIMETER-WAVE OZONE MEASUREMENTS FOR THE NETWORK FOR THE DETECTION OF STRATOSPHERIC CHANGE
Brian J. Connor and Alan Parrish (Massachusetts Univ., Amherst.) *In* NASA, Washington, NASA Upper Atmosphere Research

Program: Research Summaries 1988-1989 Jan. 1990 p 65-66 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The primary research objective is to initiate long-term monitoring of stratospheric ozone with a ground-based millimeter-wave spectrometer, the first of several such instruments projected to be part of the Network for the Detection of Stratospheric Change. The ultimate goal of this monitoring is twofold. First, to detect any secular trend in stratospheric ozone abundance, whether of natural or anthropogenic origin and, second, to provide ground-truth validation for existing and future satellite measurements of ozone. With this goal in mind, a more immediate objective is to validate the millimeter-wave measurements by tests of the instrument, internal consistency tests on the data, and most importantly, by intercomparison with all other available ozone measurements. The validation process is expected to lead to refinements in the instrument and its operating procedures and in the data analysis. The final objective is to perform short-term scientific studies with the data, including studies of the ozone diurnal and seasonal variations, and comparison of ozone variations with changes in other geophysical parameters, notably temperature and water vapor. Routine observations are now ongoing; these will allow continuing intercomparisons with the Stratospheric Aerosol and Gas Experiment (SAGE II) and one of the lidars, which is permanently on site. The experience gained during the Stratospheric Ozone Intercomparison (STOIC) caused us to refine our calibration procedures and identify the need for internal shielding of the millimeter receiver from radio frequency interference. Installation of this shielding is planned for the near future and should allow improvements in the instrument calibration and a higher signal-to-noise ratio, both of which will result in improved measurement precision. Author

N92-14509*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RETRIEVAL METHODS FOR GROUND-BASED MILLIMETER-WAVE MEASUREMENTS FOR THE NETWORK FOR THE DETECTION OF STRATOSPHERIC CHANGE
Brian J. Connor and Richard M. Bevilacqua (Naval Research Lab., Washington, DC.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 67 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The fundamental objective is to determine the information available in ground-based millimeter-wave measurements of stratospheric constituent profiles, to identify the optimum method of retrieving this profile information, and to characterize the errors in the final result. A secondary objective is to produce retrieval software for operational use with Network for the Detection of Stratospheric Change (NDSC) measurements of O3, H2O, ClO, and perhaps N2O. Tests were performed on existing ozone retrieval programs in support of ongoing NDSC field measurements. The results show that if random spectral errors and retrieval bias errors are considered, accuracy of the retrieved profile is about 5 percent from 20-50 km, and about 10 percent from 50-60 km. Author

N92-14510*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE ER-2 METEOROLOGICAL MEASUREMENT SYSTEM
K. Roland Chan *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 71-72 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objectives of ER-2 Meteorological Measurement System (MMS) are: (1) to measure the meteorological parameters (pressure, temperature, and the three dimensional wind vector) accurately; (2) to provide high resolution data on atmospheric state variables and aircraft flight track to ER-2 investigators on a timely basis; and (3) to conduct collaborative research in atmospheric dynamics and chemistry. A summary of progress and results are presented. Author

N92-14511*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ATLAS: AIRBORNE TUNABLE LASER ABSORPTION SPECTROMETER FOR STRATOSPHERIC TRACE GAS MEASUREMENTS
Max Loewenstein, James R. Podolske, and Susan E. Strahan (San Jose State Univ., CA.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 73-74 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The ATLAS instrument is an advanced technology diode laser based absorption spectrometer designed specifically for stratospheric tracer studies. This technique was used in the acquisition of N2O tracer data sets on the Airborne Antarctic Ozone Experiment and the Airborne Arctic Stratospheric Expedition. These data sets have proved valuable for comparison with atmospheric models, as well as in assisting in the interpretation of the entire ensemble of chemical and meteorological data acquired on these two field studies. The N2O dynamical tracer data set analysis revealed several ramifications concerning the polar atmosphere: the N2O/NO(y) correlation, which is used as a tool to study denitrification in the polar vertex; the N2O Southern Hemisphere morphology, showing subsidence in the winter polar vortex; and the value of the N2O measurements in the interpretation of ClO, O3, and NO(y) measurements and of the derived dynamical tracer, potential vorticity. Field studies also led to improved characterization of the instrument and to improved accuracy.
Author

N92-14512*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AMES ER-2 OZONE MEASUREMENTS
R. Pearson, Jr., James F. Vedder, and W. L. Starr *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 78-79 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective of this research is to study ozone (O3) in the stratosphere. Measurements of the ozone mixing ratio at 1 s intervals are obtained with an ultraviolet photometer which flies on the ER-2 aircraft. The photometer determines the amount of ozone in air by measuring the transmission of ultraviolet light through a fixed path with and without ambient O3 present.
Author

N92-14513*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
WHOLE AIR SAMPLER
James F. Vedder *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 80-81 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Minor constituents play an important role in upper atmospheric photochemistry and serve as tracers in transport and mixing studies in tropospheric stratospheric exchange processes. Measurements of trace gases are essential to an understanding of the mechanisms by which minor constituents originating in the troposphere, both naturally occurring and anthropogenic, reach the stratosphere; data on tracer distributions thus acquired are important in the development of models for predicting photochemical effects in the stratosphere. Author

N92-14514*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
RADIATIVE FLUX MEASUREMENTS IN THE STRATOSPHERE
Francisco P. J. Valero *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 84-85 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective is to determine how the stratospheric tropospheric exchange of water vapor is affected by the interaction of solar

(visible) and planetary (infrared) radiation with tropical cumulonimbus anvils. This research involves field measurements from the ER-2 aircraft as well as radiative transfer modelling to determine heating and cooling rates and profiles that directly affect the exchange between the troposphere and the stratosphere. Author

N92-14515*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STRATOSPHERE-TROPOSPHERE EXCHANGE PROJECT MANAGEMENT
Philip B. Russell, Estelle Condon, and Leonhard Pfister *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 93-94 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The purpose is to manage the Stratosphere Troposphere Exchange Project (STEP). This includes holding and planning science team meetings, organizing sessions at conferences devoted to the results and objectives of STEP field programs, putting together special journal issues or special sections of journal issues devoted to the results of STEP, and planning and producing technical memoranda on STEP. Summary of progress and results are given. Author

N92-14516*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AIRCRAFT DEPLOYMENT, AND AIRBORNE ARCTIC STRATOSPHERIC EXPEDITION
Estelle Condon, Adrian Tuck (National Oceanic and Atmospheric Administration, Boulder, CO.), Steve Hipskind, Brian Toon, and Steve Wegener *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 95 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The Airborne Arctic Stratospheric Expedition had two primary objectives: to study the production and loss mechanisms of ozone in the north polar stratosphere and to study the effect on ozone distribution of the Arctic Polar Vortex and of the cold temperatures associated with the formation of Polar Stratospheric Clouds. Two specially instrumented NASA aircraft were flown over the Arctic region. Each aircraft flew to acquire data on the meteorological, chemical and cloud physical phenomena that occur in the polar stratosphere during winter. The chemical processes which occur in the polar stratosphere during winter were also observed and studied. The data acquired are being analyzed. Author

N92-14517*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PARTICLE CHEMISTRY IMPACTOR EXPERIMENT
R. F. Pueschel, K. G. Snetsinger, G. V. Ferry, J. K. Goodman, and S. Verma (TMA/Norcal, Richmond, CA.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 98 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Polar stratospheric cloud (PSC) particles are collected on impactors and studied with regard to physical and chemical properties to help explain the importance of heterogeneous chemical reactions for stratospheric ozone depletion. The nitric, hydrochloric, and sulfuric acid content of stratospheric aerosol particles collected at 18 km altitude was determined. It is suggested that nitric acid is a component of polar stratospheric clouds. This is important for two reasons: (1) it proves that chlorine activation takes place at the surface of PSC particles by converting chemically inert chlorine nitrate to chlorine radicals that can react with ozone; and (2) if the PSC particles are large enough to settle out from the stratosphere, the possibility of nitric acid removal can result in the denitrification of the stratosphere. Author

N92-14518*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE LIDAR STRATOSPHERIC OZONE AND AEROSOL INVESTIGATIONS
Edward V. Browell *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 104-105 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objectives are to study the distribution of ozone (O3) and aerosols across the polar regions during the winter and spring periods and to relate these observations to chemical and dynamical processes that can contribute to the chemical perturbation of the polar stratosphere and the possible destruction of O3. The distribution and characteristics of stratospheric aerosols and polar stratospheric clouds (PSCs) are required to understand heterogeneous chemical processes that can lead to O3 depletion, and observation of O3 variations are important in the direct detection of O3 depletion and in tracing atmospheric dynamics. An airborne Differential Absorption Lidar (DIAL) system is operated in a zenith mode from the NASA DC-8 aircraft to obtain data on the large scale spatial variability of O3, and aerosol/PSC's in the lower stratosphere from about 11 to 23 km for O3, and 11 to 28 km for aerosols. The variability of O3 and aerosols/PSCs is studied in relation to chemical processes that can produce O3 depletion and to dynamics in the lower stratosphere that transport gases and aerosols inside the vortex and in some cases, across the edge of the vortex. Author

N92-14519*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AIRBORNE AEROSOL LIDAR
Lamont R. Poole and M. Patrick McCormick *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 106 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objectives are: to analyze dual polarization lidar measurements of aerosols and polar stratospheric clouds (PSCs) obtained aboard the NASA Ames DC-8 aircraft during the 1989 Airborne Arctic Stratospheric Expedition (AASE); and to combine lidar, SAM II, and other AASE data with theoretical modeling calculations to study PSC characteristics. A summary of progress and results is given. Author

N92-14520*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IN SITU OZONE MEASUREMENTS FOR THE AIRBORNE ARCTIC STRATOSPHERIC EXPERIMENT
Gerald L. Gregory *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 107 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The research provided in-situ ozone measurements onboard the NASA Ames DC-8 research aircraft during the 1989 Airborne Arctic Stratospheric Experiment. The Ames DC-8 and ER-2 aircraft performed extensive sampling of the Arctic stratosphere and troposphere in a program designed to study those factors important in ozone depletion in the Arctic during times when the polar vortex and meteorology are conducive to the formation of polar stratospheric clouds and/or an Arctic ozone hole. The DC-8 ozone instrument complement included in-situ measurements for H2O, NO, NO2, NO(y) gas, NO(y) particulate, as well as remote sensors for measuring the vertical distribution and column density of ozone above the aircraft altitude. The in-situ data (ozone, water vapor, and nitrogen species) at the aircraft altitude provide a definition of tropospheric conditions in the vicinity of the polar vortex and polar stratospheric clouds. Defining tropospheric conditions will assist in the understanding of the chemistry of both stratosphere and troposphere and the extent to which polar stratospheric clouds affect the chemistry of transported air. Author

N92-14521*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DC-8 MISSION PLANNING
Owen B. Toon *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 108 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A number of tasks needed to be performed to operate the DC-8 aircraft in the Arctic Ozone Expedition during 1989. These included development of improved navigational computer programs and performing advanced planning for flight tracks. The missions required further work in the field to plan flight tracks and to establish a data archive. The DC-8 aircraft was operated during the deployment phase of the Arctic Ozone Expedition. Data were collected revealing the presence of extensive systems of polar stratospheric clouds. The data also showed the evolution of the chlorine and nitrogen chemistry within the Arctic vortex. A navigational computer code was improved so that the DC-8 navigators could perform their function more efficiently. Author

N92-14522*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MEASUREMENT OF THE ABSOLUTE SOLAR UV IRRADIANCE AND VARIABILITY
James E. Mentall *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 111 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Radiation in the wavelength interval 150-350 nm initiates chemical reactions in the lower mesosphere and the stratosphere through the photodissociation of ambient molecular species. This experiment measures the total solar irradiance, above the Earth's atmosphere, in this wavelength interval, using three spectrometers. Measurements are made from rockets on a once-a-year basis and are used with satellite observations to determine both the absolute irradiance and the long term variability of the sun in the UV. A fourth spectrometer is being added to the payload to measure the emission in the hydrogen Lyman-alpha emission at 121.67 nm. Author

N92-14523*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
ROCKET TEMPERATURE SOUNDINGS
Francis J. Schmidlin *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 114-115 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The purpose was to provide rocket-borne measurements of temperature and wind. These data are used to: obtain a better understanding of the processes that control the chemical and dynamic behavior of the stratospheric region; monitor temperature trends and detect changes; verify and monitor remote measurements (ground- and satellite-based); and provide density measurements for large space vehicle operations. Author

N92-14524*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
BALLOON-BORNE MEASUREMENTS OF POLAR STRATOSPHERIC OZONE
Arnold L. Torres *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 119-120 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective was to provide high resolution measurements of the vertical structure of stratospheric ozone at high northern and southern latitudes, as part of a series of studies of stratospheric ozone losses over polar regions. A summary of progress and results is presented. Author

N92-14525*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
UPPER ATMOSPHERE RESEARCH: REACTION RATE AND OPTICAL MEASUREMENTS
L. J. Stief, J. E. Allen, Jr., D. F. Nava, and W. A. Payne, Jr. *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 127-128 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective is to provide photochemical, kinetic, and spectroscopic information necessary for photochemical models of the Earth's upper atmosphere and to examine reactions or reactants not presently in the models to either confirm the correctness of their exclusion or provide evidence to justify future inclusion in the models. New initiatives are being taken in technique development (many of them laser based) and in the application of established techniques to address gaps in the photochemical/kinetic data base, as well as to provide increasingly reliable information. Author

N92-14526*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INELASTIC COLLISION PROCESSES IN OZONE AND THEIR RELATION TO ATMOSPHERIC PRESSURE BROADENING
J. I. Steinfeld, C. Flannery, J. Klaassen, Y. Mizugai (Sophia Univ., Tokyo, Japan), and M. Spencer *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 155-156 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The research task employs infrared double-resonance to determine rotational energy transfer rates and pathways, in both the ground and vibrationally excited states of ozone. The resulting data base will then be employed to test inelastic scattering theories and to assess intermolecular potential models, both of which are necessary for the systematization and prediction of infrared pressure-broadening coefficients, which are in turn required by atmospheric ozone monitoring techniques based on infrared remote sensing. In addition, observation of excited-state absorption transitions will permit us to improve the determination of the 2 nu(sub 3), nu(sub 1) + nu(sub 2), and 2 nu(sub 1) rotational constants and to derive band strengths for hot-band transitions involving these levels. Author

N92-14527*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
QUANTITATIVE INFRARED SPECTROSCOPY OF MINOR CONSTITUENTS OF THE EARTH'S ATMOSPHERE
C. Chackerian, Jr., L. P. Giver, D. Goorvitch, M. Spencer, and F. P. J. Valero *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 157 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

We obtain quantitative laboratory spectroscopic measurements of molecular constituents which are of importance in understanding the health of the Earth's atmosphere, and, in particular, emphasize those species which are important for understanding stratospheric kinetics or are used for long term monitoring of the stratosphere. Our measurements provide: (1) line and band intensity values which are needed to establish limits of detectability for as yet unobserved species and to quantify the abundance of those species which are observed; (2) line-positions, -half widths and pressure induced shifts are all needed for remote sensing techniques, and (3) data on the above basic molecular parameters at temperatures and pressures appropriate for the real atmosphere. Author

N92-14528*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LABORATORY SPECTROSCOPY IN SUPPORT OF ATMOSPHERIC MEASUREMENTS
Thomas J. McGee, John Burris, William S. Heaps, and James Butler (STX Corp., Hampton, VA.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries

1988-1989 Jan. 1990 p 158-159 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Optical measurements of trace species in the atmosphere require precise, accurate spectroscopic data for the molecules under study. This laboratory exits to provide high quality spectroscopic data for the interpretation of data from existing satellite, balloon, ground, and aircraft instruments, as well as to provide sufficient data to assess the feasibility of new instruments. Author

N92-14529*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HIGH RESOLUTION SPECTROSCOPY TO SUPPORT ATMOSPHERIC MEASUREMENTS
Mary Ann H. Smith, V. Malathy Devi, Curtis P. Rinsland, D. Chris Benner (College of William and Mary, Williamsburg, VA.), and Gale A. Harvey *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 168-169 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Detailed knowledge of the molecular spectra of ozone and other infrared-active atmospheric species is needed for accurate calculation of atmospheric heating and cooling rates in climate models. Remote sensing experiments on the Nimbus-7 satellites and the Spacelab-3 Space Shuttle Mission have shown that space-based measurements of infrared absorption or emission can be used to accurately determine the concentrations and distributions of stratospheric species on a global scale. The objective of this research task is to improve knowledge of the spectroscopic line parameters (positions, intensities, assignments, halfwidths, and pressure-induced shifts) of key atmospheric constituents through laboratory measurements. Author

N92-14530*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TUNABLE FAR INFRARED STUDIES OF MOLECULAR PARAMETERS IN SUPPORT OF STRATOSPHERIC MEASUREMENTS
K. V. Chance, Ira G. Nolt, J. V. Radostitz, and K. Park (Oregon Univ., Eugene.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 180 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The purpose of this research is to make precise, fully line-resolved measurements of molecular parameters that are necessary for the analysis of spectra obtained in far infrared field measurement programs. These measurements make it possible to accurately analyze the data from field measurements to obtain atmospheric concentration profiles of key trace gases involved in the ozone chemistry. The research objectives include: measurements of pressure broadening of molecular lines of OH, O2, O3, HCl, and H2O, their temperature dependence, and, when possible, the pressure-induced frequency shifts of the lines; measurements of line positions of radical species, such as HO2. Author

N92-14531*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A FACILITY FOR HIGH RESOLUTION SPECTROSCOPY: LABORATORY AND GROUND BASED OBSERVATIONS IN SUPPORT OF UPPER ATMOSPHERIC RESEARCH
J. W. Brault, L. R. Brown, E. Cohen, J. S. Margolis, H. Pickett, R. Poynter, R. Toth, Curtis P. Rinsland, Mary Ann H. Smith, and J. J. Hillman (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) et al *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 187-188 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

This research task consists of operating a facility for making spectroscopic observations in support of upper atmospheric research. The facility responds to the needs and interests of the visiting investigators. Therefore, the research objectives are not predetermined except in broad outline. The emphasis is on studies that take advantage of the particular strengths of the Fourier Transform Spectrometer on Kitt Peak: high spectral resolution combined with wide spectral range and low noise. Author

N92-14532*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ANALYSIS OF ATMOSPHERIC SPECTRA FOR TRACE GASES
Curtis P. Rinsland, Robert K. Seals, Jr., Mary Ann H. Smith, Aaron Goldman, David G. Murcray, and Frank J. Murcray (Denver Univ., CO.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 191-192 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective is the comprehensive analysis of high resolution atmospheric spectra recorded in the middle-infrared region to obtain simultaneous measurements of coupled parameters (gas concentrations of key trace constituents, total column amounts, pressure, and temperature) in the stratosphere and upper troposphere. Solar absorption spectra recorded at 0.002 and 0.02 cm exp -1 resolutions with the University of Denver group's balloon-borne, aircraft borne, and ground-based interferometers and 0.005 to 0.01 cm exp -1 resolution solar spectra from Kitt Peak are used in the analyses. Author

N92-14533*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STRATOSPHERE CHEMISTRY IN A 2-D MODEL WITH RESIDUAL CIRCULATION
Paul D. Guthrie and Charles H. Jackman *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 207-208 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective of this research was to examine the effects of chemical perturbations on the stratosphere using models which can incorporate fully interactive radiative, chemical, and dynamical responses, in the context of a zonally averaged model. Model runs for the unperturbed, chlorine-perturbed and simultaneously chlorine-and CO2-perturbed cases were completed using the JPL-87 chemical kinetics data. The base case was analyzed and submitted for publication. The perturbed cases show substantial sensitivity of the predicted column ozone depletion to the perturbations affecting lower stratosphere temperature, but less to far dynamical perturbations. The column ozone distribution changed substantially when the kinetics data was changed. This implies a greater-than-expected uncertainty in predicted latitude distributions of ozone depletion, due to uncertainty about the accuracy and completeness of the chemical kinetics data set. Author

N92-14534*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FAST TWO-DIMENSIONAL MODEL
Charles H. Jackman, Anne R. Douglass, Richard S. Stolarski, Paul D. Guthrie, and A. M. Thompson *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 209-210 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A two dimensional (altitude and latitude) model of the atmosphere is used to investigate problems relating to the variability of the dynamics and temperature of the atmosphere on the ozone distribution, solar cycle variations of atmospheric constituents, the sensitivity of model results to tropospheric trace gas sources, and assessment computations of changes in ozone related to manmade influences. In a comparison between two dimensional model results in which the odd nitrogen family was transported together and model results in which the odd nitrogen species was transported separately, it was found that the family approximations are adequate for perturbation scenario calculations. Author

N92-14535*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRATOSPHERIC DYNAMICS AND TRANSPORT STUDIES
William L. Grose, R. E. Turner, W. T. Blackshear, and R. S. Eckman *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 218 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A three dimensional General Circulation Model/Transport Model is used to simulate stratospheric circulation and constituent distributions. Model simulations are analyzed to interpret radiative, chemical, and dynamical processes and their mutual interactions. Concurrent complementary studies are conducted using both global satellite data and other appropriate data. Comparisons of model simulations and data analysis studies are used to aid in understanding stratospheric dynamics and transport processes and to assess the validity of current theory and models. Author

N92-14536*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
STRATOSPHERIC CHEMISTRY AND TRANSPORT
Michael Prather and Maria M. Garcia (Columbia Univ., New York, NY.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 219-220 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A Chemical Tracer Model (CTM) that can use wind field data generated by the General Circulation Model (GCM) is developed to implement chemistry in the three dimensional GCM of the middle atmosphere. Initially, chemical tracers with simple first order losses such as N2O are used. Successive models are to incorporate more complex ozone chemistry. Author

N92-14537*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STRATOSPHERIC DYNAMICS
Richard E. Young, James B. Pollack, and Owen B. Toon *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 222-223 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A global circulation model is being used to study the dynamical behavior of stratospheric planetary waves (waves having horizontal wavelengths of tens of thousands of kilometers) forced by growing cyclonic disturbances of intermediate scale, typically with wavelengths of a few thousand kilometers, which occur in the troposphere. Planetary scale waves are the dominant waves in the stratosphere, and are important for understanding the distribution of atmospheric trace constituents. Planetary wave forcing by intermediate scale tropospheric cyclonic disturbances is important for producing eastward travelling planetary waves of the sort which are prominent in the Southern Hemisphere during winter. The same global circulation model is also being used to simulate and understand the rate of dispersion and possible stratospheric climatic feedbacks of the El Chichon volcanic aerosol cloud. By comparing the results of the model calculation with an established data set now in existence for the volcanic cloud spatial and temporal distribution, stratospheric transport processes will be better understood, and the extent to which the cloud modified stratospheric wind and temperature fields can be assessed.
Author

N92-14538*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STRATOSPHERIC GENERAL CIRCULATION WITH CHEMISTRY MODEL (SGCCM)
Richard B. Rood, Anne R. Douglass, Marvin A. Geller, Jack A. Kaye, J. Eric Nielsen (Applied Research Corp., Landover, MD.), Joan E. Rosenfield, and Richard S. Stolarski *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 224-227 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

In the past two years constituent transport and chemistry experiments have been performed using both simple single constituent models and more complex reservoir species models. Winds for these experiments have been taken from the data assimilation effort, Stratospheric Data Analysis System (STRATAN). Author

N92-14539*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STRATOSPHERIC DATA ANALYSIS SYSTEM (STRATAN)
Richard B. Rood, Michael Fox-Rabinovitz, David J. Lamich (Centel Federal Services Corp., Reston, VA.), Paul A. Newman, and James W. Pfaendtner *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 228-231 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A state of the art stratospheric analyses using a coupled stratosphere/troposphere data assimilation system is produced. These analyses can be applied to stratospheric studies of all types. Of importance to this effort is the application of the Stratospheric Data Analysis System (STRATAN) to constituent transport and chemistry problems. Author

N92-14540*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STUDIES OF STRATOSPHERIC PARTICULATES
Owen B. Toon, Richard Turco, Patrick Hamill, and Gary Thomas (Colorado Univ., Boulder.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 237-238 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

A sophisticated computer model of polar stratospheric clouds was developed and used to study the properties of ice clouds. The model has recently been extended to investigate nitric acid clouds and ice clouds as well as their interactions with stratospheric gases. The model is now being applied to interpret data collected during recent expeditions to the Antarctic and the Arctic. Some work has also been done to understand the properties of noctilucent clouds and their implications for the chemistry and dynamics of the upper stratosphere. Author

N92-14541*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HOMOGENEOUS AND HETEROGENEOUS CHEMISTRY ALONG AIR PARCEL TRAJECTORIES
R. L. Jones, D. L. McKenna, L. R. Poole, and S. Solomon (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 239-240 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The study of coupled heterogeneous and homogeneous chemistry due to polar stratospheric clouds (PSC's) using Lagrangian parcel trajectories for interpretation of the Airborne Arctic Stratosphere Experiment (AASE) is discussed. This approach represents an attempt to quantitatively model the physical and chemical perturbation to stratospheric composition due to formation of PSC's using the fullest possible representation of the relevant processes. Further, the meteorological fields from the United Kingdom Meteorological office global model were used to deduce potential vorticity and inferred regions of PSC's as an input to flight planning during AASE. Author

N92-14542*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THEORETICAL MODELLING AND METEOROLOGICAL ANALYSIS FOR THE AASE MISSION
Mark R. Schoeberl, Paul A. Newman, Joan E. Rosenfield (Universities Space Research Association, Greenbelt, MD.), and Richard S. Stolarski *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989

Jan. 1990 p 244-245 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Providing real time constituent data analysis and potential vorticity computations in support of the Airborne Arctic Stratospheric Experiment (AASE) is discussed. National Meteorological Center (NMC) meteorological data and potential vorticity computations derived from NMC data are projected onto aircraft coordinates and provided to the investigators in real time. Balloon and satellite constituent data are composited into modified Lagrangian mean coordinates. Various measurements are intercompared, trends deduced and reconstructions of constituent fields performed. Author

N92-14543*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
CLIMATOLOGICAL STRATOSPHERIC MODELING
David Rind *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 262 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The Goddard Institute for Space Studies (GISS) Three dimensional Global Climate/Middle Atmosphere Model was used to investigate the effect of doubled carbon dioxide on the middle atmosphere. Carbon dioxide was doubled in both the troposphere and stratosphere, and the sea surface temperatures were increased in accordance with results from the GISS climate model. Additional experiments were run with different sea surface temperature distributions, and doubling the carbon dioxide only in the troposphere or stratosphere. Author

N92-14544*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
UPPER ATMOSPHERE DYNAMICS
Timothy L. Miller and Nathaniel D. Reynolds (Alabama Univ., Huntsville.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 268 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The spatial distribution of stratospheric ozone is useful in diagnosis of some features of the large scale atmospheric circulation, and the ozone may also interact with the atmospheric general circulation. Local maxima in the column ozone distribution are often associated with disturbances in the lower stratosphere and upper troposphere, which may herald cyclone development in the troposphere. One research objective is to explore these issues by means of time series analysis of a zonal index of total column ozone, to suggest the existence or nonexistence of relationships between column ozone and dynamical processes which are known to occur on various time scales. Another objective is to investigate the correlation between the ozone mixing ratio on the 350 K isentropic surface and the column integrated ozone, and to investigate the use of an easily derived parameter as a proxy for ozone mixing ratio, which is conserved in the stratosphere for time scales shorter than the photochemical time scale. The source of data for these studies is the Total Ozone Mapping Spectrometer (TOMS) data set. Author

N92-14545*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ANALYSIS OF OBSERVATIONS OF THE MIDDLE ATMOSPHERE FROM SATELLITES
Ellis E. Remsberg, James M. Russell, III, William L. Grose, Thomas Miles, Larry L. Gordley, Alan ONeill, and Duncan Fairlie (Meteorological Office, Bracknell, England) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 275-276 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Satellite data are being used to investigate problems in middle atmosphere chemistry and dynamics. Efforts have been focused primarily on studies to determine the quality of observed distributions of trace species and derived dynamical quantities. Those data have been used as diagnostics for model-derived constituent profiles and fields and for improving our understanding of some of the fundamental processes occurring in the middle atmosphere. Temperatures and derived winds from Nimbus 7 Limb Infrared Monitoring of the Stratosphere (LIMS) data were compared with long-time series of rawinsonde data at Invercargill, New Zealand, and Berlin, West Germany, and the results are excellent for both quantities. It was also demonstrated that more highly-derived dynamical quantities can be obtained reliably from those LIMS fields. Furthermore, both the diabatic and residual-mean circulations derived using LIMS data agree qualitatively with changes in the distribution of trace species determined independently with the Nimbus 7 SAMS and LIMS experiments. Subsequently, an examination of LIMS data at mid to high latitudes of the Southern Hemisphere has revealed a synoptic-scale, upper stratospheric instability during late autumn that is associated with the development of the stratospheric polar jet. Investigation of this phenomenon continues with Stratospheric Sounding Unit (SSU) data sets. Author

N92-14546*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ESTIMATING STRATOSPHERIC TEMPERATURE TRENDS USING SATELLITE MICROWAVE RADIANCES
Robert D. Hudson, Paul A. Newman, and Mark R. Schoeberl *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 279-280 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective was to evaluate and intercompare stratospheric temperatures using Microwave Sounding Unit (MSU) data as a basis data set. The MSU, aboard the NOAA polar orbiter satellite series, provides twice daily global coverage over a layer (50-150 mb) at approximately a (170km)(exp 2) resolution. Conventional data sets will be compared to the satellite data in the lower stratosphere in order to assess their quality for trend computations. Author

N92-14547*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ANALYSIS OF STRATOSPHERIC OZONE, TEMPERATURE, AND MINOR CONSTITUENT DATA
Richard S. Stolarski, Anne R. Douglass (Universities Space Research Association, Greenbelt, MD.), Charles H. Jackman, Jack A. Kaye, and Richard B. Rood *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 282-283 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective of this research is to use available satellite measurements of temperature and constituent concentrations to test the conceptual picture of stratospheric chemistry and transport. This was originally broken down into two sub-goals: first, to use the constituent data to search for critical tests of our understanding of stratospheric chemistry and second, to examine constituent transport processes emphasizing interactions with chemistry on various time scales. A third important goal which has evolved is to use the available solar backscattered ultraviolet (SBUV) and Total Ozone Mapping Spectrometer (TOMS) data from Nimbus 7 to describe the morphology of recent changes in Antarctic and global ozone with emphasis on searching for constraints to theories. The major effort now being pursued relative to the two original goals is our effort as a theoretical team for the Arctic Airborne Stratospheric Expedition (AASE). Our effort for the AASE is based on the 3D transport and chemistry model at Goddard. Our goal is to use this model to place the results from the mission data in a regional and global context. Specifically, we set out to make model runs starting in late December and running through March of 1989, both with and without heterogeneous chemistry. The transport is to be carried out using dynamical fields from a 4D data assimilation model being developed under separate funding from this task. We have successfully carried out a series of single constituent transport experiments. One of the things demonstrated by these

runs was the difficulty in obtaining observed low N2O abundances in the vortex without simultaneously obtaining very high ozone values. Because the runs start in late December, this difficulty arises in the attempt to define consistent initial conditions for the 3D model. To accomplish a consistent set of initial conditions, we are using the 2D photochemistry-transport model of Jackman and Douglass and mapping in potential temperature, potential vorticity space as developed by Schoeberl and coworkers. Author

N92-14548*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ANALYSIS AND INTERPRETATION OF VARIABILITIES IN OZONE AND TEMPERATURE FIELDS
S. Chandra *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 290-291 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The temporal and spatial variabilities were studied of short and long term fluctuations in stratospheric ozone and temperature at various pressure levels using several years of ozone, temperature, and solar flux data from Nimbus 4, Nimbus 7, and SME satellites. Some results are as follows: (1) the solar UV flux and various indices of solar activity indicate a strong period at about 5 months; (2) satellite total ozone observations were analyzed using 17 years of data from the Nimbus 4 BUV and the Nimbus 7 SBUV experiments, which show very similar seasonal variations and quasibiennial oscillation (QBO) with some indication of a 4 year component; and (3) the zonal characteristics of both the ozone and temperature trends were derived from ten years of total ozone and 50 mb temperature based on the Nimbus 7 TOMS measurements and the NMC analyses respectively. Author

N92-14549*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ANALYSIS OF SATELLITE DATA TO DEDUCE STRATOSPHERIC CONSTITUENTS AND UV SPECTROSCOPIC PROPERTIES OF THE ATMOSPHERE
Richard D. McPeters *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 292-293 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The objective is to better understand the stratosphere, its constituents, and its ultraviolet optical properties, through detailed analysis of data from the SBUV instrument on Nimbus 7 and comparison with data from other instruments, including the NOAA 9 SBUV 2, SAGE, SME, and SMM. One conclusion to be drawn from the Ozone Trends Panel report is that there are unresolved differences in the ozone profiles measured by different instruments. While the purpose of the work is more to understand the details of the UV radiation field in the stratosphere than it is to assess the accuracy of the SBUV ozone measurement itself, improved understanding of specific problems in the UV will lead to more accurate ozone retrievals. Areas of study include the effect of aerosols on the backscattered albedo, the shape of the ozone profile near the stratopause, the effect of possible polar mesospheric clouds, and the measureability of nitric oxide and sulfur dioxide. Author

N92-14550*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SMM MESOSPHERIC OZONE MEASUREMENTS
A. C. Aikin *In* NASA, Washington, NASA Upper Atmopshere Research Program: Research Summaries 1988-1989 Jan. 1990 p 301-302 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The main objective was to understand the secular and seasonal behavior of ozone in the lower mesosphere, 50 to 70 km. This altitude region is important in understanding the factors which determine ozone behavior. A secondary objective is the study of stratospheric ozone in the polar regions. Use is made of results from the SBUV satellite borne instrument. In the Arctic the interaction between chlorine compounds and low molecular weight hydrocarbons is studied. More than 30,000 profiles were obtained using the UVSP instrument on the SMM spacecraft. Several orbits of ozone data per day were obtained allowing study of the current rise in solar activity from the minimum until the present. Analysis of Nimbus 7 SBUV data in Antarctic spring indicates that ozone is depleted within the polar vortex relative to ozone outside the vortex. This depletion confirms the picture of ozone loss at altitudes where polar stratospheric clouds exist. In addition, there is ozone loss above the cloud level indicating that there is another mechanism in addition to ozone loss initiated by heterogeneous chlorine reactions on cloud particles. Author

N92-14551*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DATA ANALYSIS AND ARCHIVAL
Edwin F. Danielsen, Leonhard Pfister, R. Stephen Hipskind, and Steven E. Gaines (Sterling Software, Moffett Field, CA.) *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 314 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The purpose of this task is the acquisition, distribution, archival, and analysis of data collected during and in support of the Upper Atmospheric Research Program (UARP) field experiments. Meteorological and U2 data from the 1984 Stratosphere-Troposphere Exchange Project (STEP) was analyzed to determine characteristics of internal atmospheric waves. CDROM's containing data from the 1987 STEP, 1987 Airborne Antarctic Ozone Expedition (AAOE), and the 1989 Airborne Arctic Stratospheric Expedition (AASE) were produced for archival and distribution of those data sets. The AASE CDROM contains preliminary data and a final release is planned for February 1990. Comparisons of data from the NASA ER-2 Meteorological Measurement System (MMS) with radar tracking and radiosonde data show good agreement. Planning for a Meteorological Support Facility continues. We are investigating existing and proposed hardware and software to receive, manipulate, and display satellite imagery and standard meteorological analyses, forecasts, and radiosonde data. Author

N92-14552*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYSIS OF TROPOSPHERE-STRATOSPHERE EXCHANGE
Leonhard Pfister *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 315-316 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

The overall goal is to improve our understanding of stratosphere-troposphere exchange processes in the tropics and midlatitudes. Specifically, modeling and analysis are performed using aircraft, radiosonde, and satellite data from the 1980 and 1987 NASA tropical field experiments in Panama and Australia, respectively, and the 1986 NASA jet stream field experiment in California. The objectives are to: (1) examine the structure of ozone, temperature, horizontal winds, tropospheric tracers, water and ice particles, and water vapor within, around, and above cumulus anvils in the tropics and jet streams in midlatitudes; (2) establish the presence, during each of the experimental periods, of various potential mechanisms of exchange, such as direct injection by cumulus, gravity wave fluxes, turbulent fluxes, and radiative heating; and (3) evaluate quantitatively, if possible, the mass of air transferred by these mechanisms during specific transport events. Author

N92-14553*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
UPPER ATMOSPHERE DATA PROGRAM (UADP)
R. K. Seals, Jr. *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 362 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Rapid, effective access to the increasing volume of information on stratospheric trace gases, both from measurements and model

calculations, is important in advancing our knowledge of the Earth's atmosphere. The data have their origins in a variety of sources, ranging from satellite experiments and 2-D model predictions to individual balloon measurements, and are found in a variety of locations and formats. This task focuses on development and operation of an electronic data base for such trace gas data. The objectives are to provide effective access to these diverse data sets; to foster electronic data access, manipulation, and display; and to support periodic assessment and intercomparison activities. Author

N92-14554*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MISSION AND SAMPLING ANALYSES FOR ATMOSPHERIC SATELLITE EXPERIMENTS
Edwin F. Harrison *In* NASA, Washington, NASA Upper Atmosphere Research Program: Research Summaries 1988-1989 Jan. 1990 p 363-364 (For primary document see N92-14499 05-46)
Avail: NTIS HC/MF A15 CSCL 04A

Orbital analyses, instrument-viewing geometry studies, and sampling simulations are performed to define mission concepts for advanced atmospheric research satellite experiments. These analyses are conducted in collaboration with NASA Headquarters and working groups consisting of atmospheric scientists and experiment developers. Analytical techniques are developed and used to optimize geographical coverage, sensor-viewing geometries, data gathering strategies, sampling schemes, orbital characteristics, satellite launch times, and operational modes of the various experiments and mission concepts. Short-term (7 day) Shuttle Missions, the Upper Atmosphere Research Satellite (UARS), and multisatellite missions such as the Earth Observing System (EOS) are being studied. Atmospheric experiments which are being analyzed include nadir-viewing sounders, limb-emission scanners, laser systems, and solar-occultation techniques. Author

N92-14555*# Massachusetts Inst. of Tech., Cambridge.
FLEXURAL DEFORMATION OF THE CONTINENTAL LITHOSPHERE Final Report
20 Feb. 1990 23 p
(Grant NAG5-532)
(NASA-CR-189474; NAS 1.26:189474) Avail: NTIS HC/MF A03 CSCL 08G

Prior work focused primarily on the Adriatic and northern Ionian regions. The results of these studies have been summarized previously, and so are only briefly discussed. More recent work focuses on two different topics: (1) analysis of foredeep basin geometry, sedimentary style, and thrust belt structure in light of the kinematics at the associated plate boundary and subduction zone dynamics; and (2) the evolution and plate strength of early Proterozoic lithosphere. Author

N92-14556# International Centre for Theoretical Physics, Trieste (Italy).
GENERALIZED EXPRESSIONS FOR VARIATIONS IN CRITICAL FREQUENCIES, ELECTRON DENSITIES AND ALTITUDES OF THE IONOSPHERIC LAYERS
E. C. Njau Dec. 1990 12 p
(DE91-635168; IC-90/439) Avail: NTIS HC/MF A03

We develop generalized mathematical expressions for time and space variations of peak electron densities of the ionospheric D, E, F1 and F2 layers as well as corresponding variations in the altitudes of the electron density peaks in each of these layers. On the basis of the Chapman characteristics of the E and F1 layers and other techniques, a generalized expression is developed for the electron density height profile of each of the four ionospheric layers. Consequently a generalized mathematical expression is developed for the entire electron density height profile of the whole ionosphere as a function of time, latitude and longitude. The latter mathematical expression may be used to compute or predict ionospheric parameters associated with radio and satellite communications. Finally we show that some well documented equations on ionospheric parameters are simplified (or approximated) versions of some of our mathematical expressions. DOE

N92-14557# Lawrence Livermore National Lab., CA.
HIGH-FREQUENCY P WAVE SPECTRA FROM EXPLOSIONS AND EARTHQUAKES
W. R. Walter and K. F. Priestley (Nevada Univ., Reno.) Aug. 1991 26 p Presented at the DOE/LLNL Symposium on Explosion-Source Phenomenology, Lake Tahoe, CA, 14-16 Mar. 1989
(Contract W-7405-eng-48)
(DE91-018723; UCRL-JC-108141; CONF-890398-2) Avail: NTIS HC/MF A03

Two explosion P wave spectral models and two earthquake P wave spectral models are reviewed to assess their implications for high frequency (greater than 1 Hz) seismic discrimination between earthquakes and explosions. The importance of the corner frequency scaling, particularly for models with the same high frequency spectral decay rate, is demonstrated by calculating source spectral ratios (a potentially important regional discriminant) for these models. We compare North American events and a limited data set of Central Asian events with these spectral models. We find North American earthquakes are consistent with a constant stress drop modified Brune model between 10 and 30 Hz. Shallow (less than 700 m depth) Pahute Mesa explosions at the Nevada Test Site have a high frequency spectral decay between 10 and 30 Hz greater than the omega (exp -2) predicted by the explosion models. Near regional recordings of the Soviet Joint Verification Experiment (JVE) explosion show a higher corner frequency and lower 1 to 4 Hz spectral ratios than predicted by either explosion model. The higher corner frequency of the Soviet JVE appears not to be due to attenuation, or receiver effects, and may represent a need for different corner frequency scaling, or result from source complications such as spall and tectonic release. A regional recording of the Soviet JVE (NEIC m sub b equals 6.1) is shown to have a lower 1 to 4 Hz spectral ratio than a smaller earthquake (NEIC m sub b equals 4.6) recorded on a nearly reciprocal path. DOE

N92-14558# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
ENERGY-MOMENTUM TENSOR OF THE GRAVITATIONAL FIELD FOR MATERIAL SPHERES
S. N. Sokolov 1989 14 p
(DE91-628070; IFVE-OTF-89-117; IHEP-OTF-89-117) Avail: NTIS HC/MF A03

The density of the energy-momentum tensor of a gravitational field which can be defined in the general relativity with the help of the ideas of the relativistic gravitational theory is found for the case of material spheres. The relationship of this quantity with the Riemann tensor R(sub alpha beta gamma delta) is discussed. DOE

N92-14559# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj Fiziki.
EXTENDED (N=4) SUPERGRAVITY AS A RESULT OF REDUCTION FROM 10-DIMENSIONAL SPACE
M. V. Terentyev 1988 24 p
(DE91-628071; ITEP-120-88) Avail: NTIS HC/MF A03

The reduction of N=1 supergravity from 10-dimensional space R(exp 10) to the usual space-time R(exp 4) is fulfilled in such a way that only fields of the extended (N=4) supergravity multiplet are survived. As a result, the Cremmer, Sherk and Ferrara (CSF) action of N=4 supergravity are obtained. With framework of the method used in the present paper, it is possible to construct the interaction of N=4 supergravity with one N=4 matter multiplet. DOE

N92-14560*# Colorado Univ., Boulder.
GRAVITY AND THE GEOID IN THE NEPAL HIMALAYA Semiannual Report

Roger Bilham 1 Jan. 1992 41 p
(Grant NAGw-2704)
(NASA-CR-189523; NAS 1.26:189523) Avail: NTIS HC/MF A03 CSCL 08E

Materials within the Himalaya are rising due to convergence between India and Asia. If the rate of erosion is comparable to the rate of uplift, the mean surface elevation will remain constant. Any slight imbalance in these two processes will lead to growth or attrition of the Himalaya. Although buried rocks, minerals and surface control points in the Himalaya are undoubtably rising, the growth or collapse or the Himalaya depends on the erosion rate which is invisible to geodetic measurements. A way to measure erosion rate is to measure the rate of change of gravity in a region of uplift. Essentially gravity should change precisely in accord with a change in elevation of the point in a free air gradient if erosion equals uplift rate. A measurement of absolute gravity was made simultaneously with measurements of GPS height within the Himalaya. Absolute gravity is estimated from the change in velocity per unit distance of a falling corner cube in a vacuum. Time is measured with an atomic clock and the unit distance corresponds to the wavelength of an iodine stabilized laser. An experiment undertaken in the Himalaya in 1991 provide a site description also with a instrument description. Author

N92-14561# National Science Foundation, Washington, DC. Polar Information Program.
ANTARCTIC NEWS CLIPS, 1991
6 Aug. 1991 140 p
(NSF-91-79) Avail: NTIS HC/MF A07

Published stories are presented that sample a year's news coverage of Antarctica. The intent is to provide the U.S. Antarctic Program participants with a digest of current issues as presented by a variety of writers and popular publications. The subject areas covered include the following: earth science; ice studies; stratospheric ozone; astrophysics; life science; operations; education; antarctic treaty issues; and tourism Author

N92-14562# Interagency Arctic Research Policy Committee, Washington, DC.
ARCTIC RESEARCH OF THE UNITED STATES, VOLUME 5
Jerry Brown, ed. and Stephen Bowen, ed. (Army Cold Regions Research and Engineering Lab., Hanover, NH.) 1991 103 p
Avail: NTIS HC/MF A06

This journal is for people and organizations interested in learning about U.S. Government-financed Arctic research activities. The following are presented: (1) reports on current and planned U.S. Government-sponsored research in the Arctic; (2) reports of the Arctic Research Commission (ARC) and the Interagency Arctic Research Policy Committee (IARPC) meetings; (3) summaries of other current and planned Arctic research, including that of Alaska, local governments, the private sector, and other nations; and (4) a calendar of forthcoming local, national, and international meetings. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-14563 Washington Univ., Seattle.
RETRIEVAL OF PRESSURE, TEMPERATURE AND CLOUD STRUCTURE IN FRONTAL RAINBANDS Ph.D. Thesis
Bart Geerts 1990 185 p
Avail: Univ. Microfilms Order No. DA9117945

The combined retrieval of thermodynamic and cloud microphysical variables, using dual-Doppler radar measurements and a cloud model, is used to analyze wintertime frontal rainbands on the mid-Atlantic Coast of the United States. Airborne measurements, soundings, and high-resolution surface observations are also employed in this study. Water vapor, cloud water, cloud ice, rain, and snow are parameterized in the cloud model, subject to a temperature distribution that is constrained to a dynamical balance. Temperature is derived from buoyancy. The combined retrieval technique is shown to be a useful tool in analyzing force balances and assessing water and energy budgets in precipitating mesoscale systems. One rainband, observed in 6 March 1986, was characterized by weak vertical velocities. Because the rainband was to a high degree two-dimensional and in steady state, some important simplifications are possible. Retrieval results indicate that this rainband was driven by mid-level forcing, making the air conditionally symmetrically unstable. The mid-level forcing was associated with a weak, trailing cold front aloft. The air flow and the retrieved thermodynamic structure suggest that on the meso-beta scale, the cold front aloft was a mid-level intrusion of colder and mainly drier air. The retrieval results demonstrate that the cold front aloft interacted dynamically with the planetary boundary layer below. Another rainband, observed on 26 January 1986 over the Gulf Stream offshore of Cape Hatteras, was exceptionally deep (12 km) and more vigorous than the March 6 rainband. The rainband was also fully three-dimensional and more transient. Therefore, it did not satisfy the basic assumptions of the retrieval model as well as the March 6 rainband. Large pressure and buoyancy perturbations and heavy precipitation were retrieved in one section across and one section along this rainband.
Dissert. Abstr.

N92-14564# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostics Lab.
THE SECOND FRONT RANGE LIDAR, AIRCRAFT, AND BALLOON EXPERIMENT
Barry A. Bodhaine, John J. DeLuisi, Joey F. Boatman, Kim Young, Dennis L. Wellman, R. L. Gunter, M. J. Post, Richard E. Cupp, Terry McNice, and James M. Rosen (Wyoming Univ., Laramie.) et al Jun. 1991 149 p
(PB91-205567; NOAA-DR-ERL-CMDL-8) Avail: NTIS HC/MF A07 CSCL 04B

The first Front Range Lidar, Aircraft, and Balloon (FRLAB) experiment was performed near Boulder, Colorado on 26 Jul. 1989, and the second FRLAB experiment was performed on 23-24 May 1990. The experiments made simultaneous measurements of aerosol profiles in the atmosphere using CO2, ruby, Nd:YAG, and Erbium:Glass lidars; airborne nephelometer, condensation nucleus (CN) counter, and aethalometer; and balloonborne backscattersonde. The data allow a direct comparison between several diverse types of instruments as well as a quantitatively consistent evaluation of the amount of non Rayleigh scattering occurring in the tropospheric clean region where lidar profiles are often normalized. GRA

N92-14565 National Oceanic and Atmospheric Administration, Washington, DC. Office of Research and Applications.
WATER VAPOR IMAGERY: INTERPRETATION AND APPLICATIONS TO WEATHER ANALYSIS AND FORECASTING
Roger B. Weldon and Susan J. Holmes Apr. 1991 219 p
(NOAA-TR-NESDIS-57) Avail: NTIS HC/MF A10

In part one, satellite radiation measurements in the 6.7 and 7.3 micron bands are compared to atmospheric moisture and temperature soundings. Concepts developed from a computer mode of radiation transfer are related to satellite observations and radiosonde data. In part two, patterns and features observed on 6.7 micron satellite imagery data are related to atmospheric wind and temperature fields. Applications of water vapor imagery to weather analysis and forecasting are suggested. Author

N92-14566# National Climatic Data Center, Asheville, NC.
US NAVY REGIONAL CLIMATIC STUDY OF THE BARENTS SEA AND ADJACENT WATERS Final Report
William A. Brower, Jr., Ronald G. Baldwin, and Phala L. Franks Sep. 1990 242 p
(AD-A241115; NAVAIR-50-1C-558) Avail: NTIS HC/MF A11 CSCL 04/2

This climatic study covers the Barents Sea and adjacent waters between 67 and 80 degs north latitudes and 04 and 56 degs east longitudes. This climatic study of marine environment consists of monthly charts and tables of: (1) clouds; (2) atmospheric

precipitation; (3) visibility tables; (4) ceiling-visibility (mid-range/low range); (5) wind-visibility-cloudiness; (6) scalar mean wind speed; (7) wind speed less than 11 and greater or equal to 34 knots; (8) wind speed 11-21 and 22-33 knots; (9) surface wind roses; (10) air and sea temperature, (11) wave height-isopleths, (12) wave height tables, and (13) surface currents (seasonal). GRA

N92-14567# International Centre for Theoretical Physics, Trieste (Italy).
A NEW PROCESS BY WHICH THE GENERAL CIRCULATION SYSTEM IS MAINTAINED
E. C. Njau Dec. 1990 8 p
(DE91-635154; IC-90/402) Avail: NTIS HC/MF A02

According to the author's theory of climatic change (Nuovo Cimento C, 12, 597-611 (1989)), heat energy or temperature variations at any location on the earth may be expressed as a power series of some specific functions. These functions represent amplitude modulation processes in which the complex carrier signals are generated by interactions between the earth and its spinning motion on one hand and the constant component of extraterrestrial insolation on the other hand, while the modulating signals are formed by the variable components of extraterrestrial insolation. It is shown here that the latitudinal variation of the modulation indices involved in the above-mentioned processes leads to the establishment and maintenance of atmospheric stability along the intertropical as well as polar high pressure belts. Besides, a high level of atmospheric instability is permanently enforced along the subpolar low pressure belts. All the modulation indices attain minimum values along the equatorial low pressure belt and maximum values along the subpolar low pressure belts. Our analysis reflects and explains quite well the salient characteristics of the general circulation system already deduced from observations. DOE

N92-14568# International Centre for Theoretical Physics, Trieste (Italy).
AN ANALYTICAL MODEL FOR CLIMATIC PREDICTIONS
E. C. Njau Dec. 1990 8 p
(DE91-635156; IC-90/409) Avail: NTIS HC/MF A02

A climatic model based upon analytical expressions is presented. This model is capable of making long-range predictions of heat energy variations on regional or global scales. These variations can then be transformed into corresponding variations of some other key climatic parameters since weather and climatic changes are basically driven by differential heating and cooling around the earth. On the basis of the mathematical expressions upon which the model is based, it is shown that the global heat energy structure (and hence the associated climatic system) are characterized by zonally as well as latitudinally propagating fluctuations at frequencies downward of 0.5 day(exp -1). We have calculated the propagation speeds for those particular frequencies that are well documented in the literature. The calculated speeds are in excellent agreement with the measured speeds. DOE

N92-14569# International Centre for Theoretical Physics, Trieste (Italy).
PHYSICAL PROCESSES RESPONSIBLE FOR ENSO EVENTS
E. C. Njau Dec. 1990 13 p
(DE91-635166; IC-90/432) Avail: NTIS HC/MF A03

We use the author's theory of sun-weather/climate links and climatic change to develop and explain the physical processes which give rise to El Nino and Southern Oscillation (ENSO) events. Our analysis apparently accounts well for all major characteristics of ENSO events already established from past observations. Finally we propose possible ways by which future ENSO events may be predicted. DOE

N92-14570 Royal Netherlands Meteorological Inst., De Bilt. Physical Meteorology Dept.
FLUX-PROFILE RELATIONSHIPS IN THE NOCTURNAL BOUNDARY LAYER
Pim Bouwman 1990 139 p
(KNMI-TR-130; ISSN-0169-1708; ETN-92-90687) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

For three months continuous turbulence measurements were made to obtain flux profile relationships in the nocturnal boundary layer at Cabauw, the Netherlands. A sonic anemometer and a fast thermocouple were used for flux computations by the eddy correlation technique. The routine measurements along the 213 m meteorological data provided profiles for windspeed and temperature as well as additional micro meteorological information. Data reduction was performed online. Monin-Obukhov similarity functions were obtained using the local scaling approach in the surface layer. The results indicate that the slopes (beta) of the similarity functions (phi = alpha + beta Z/L, beta = 3) found are much lower than the slopes (beta = 10) found by Cuypers (1987) using Nieuwstadt's (1984) data. Terrain inhomogeneities seem to cause a translation of the similarity functions along the y-axis, they do not change the slope. The low slopes found compared to others in the literature ask for an explanation. Further analysis of the existing dataset or another experiment should give this explanation. The slope found by Cuypers does definitely not agree with the slope found. ESA

N92-14571# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Meteorologische Fernerkundung.
SHADOW TECHNIQUE FOR IMPROVED INVERSION OF LIDAR DATA TO CIRRUS AND CONTRAIL OPTICAL DEPTH
Gerhard H. Ruppersberg and Wolfgang Renger Jul. 1990 20 p In GERMAN; ENGLISH summary Translation was announced as ESA-TT-1263
(DLR-FB-91-07; ISSN-0939-2963; ETN-92-90327) Avail: NTIS HC/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 8.50 DM

Color coded plots of cirrus fields, gathered by an airborne vertically upward pointing backscatter lidar during the International Cirrus Experiment in 1989, show remarkable shadowing effects in presence of an underlying contrail. Using this shadowing effect the lidar system can be calibrated to determine extinction coefficients within the shadowing layer with an accuracy of +/-20 percent. A change of the sigma/beta relation within the shadowing layer can be quantitatively determined and localized. To calculate the extinction outside this layer, an assumption about its sigma/beta relation has to be made. This 'shadow calibration' is capable of supporting the often used Klett inversion technique. It should also be applicable for groundbased, vertically upward pointing lidars as well as allowing for new data interpretation of downward looking systems. ESA

N92-14572*# Rhode Island Univ., Kingston. Graduate School of Oceanography.
PEM-WEST TRAJECTORY CLIMATOLOGY AND PHOTOCHEMICAL MODEL SENSITIVITY STUDY PREPARED USING RETROSPECTIVE METEOROLOGICAL DATA
John T. Merrill and Jose M. Rodriguez (Atmospheric and Environmental Research, Inc., Cambridge, MA.) 1991 50 p (Grant NAG1-1235)
(NASA-CR-188128; NAS 1.26:188128) Avail: NTIS HC/MF A03 CSCL 04B

Trajectory and photochemical model calculations based on retrospective meteorological data for the operations areas of the NASA Pacific Exploratory Mission (PEM)-West mission are summarized. The trajectory climatology discussed here is intended to provide guidance for flight planning and initial data interpretation during the field phase of the expedition by indicating the most probable path air parcels are likely to take to reach various points in the area. The photochemical model calculations which are discussed indicate the sensitivity of the chemical environment to various initial chemical concentrations and to conditions along the trajectory. In the post-expedition analysis these calculations will be used to provide a climatological context for the meteorological conditions which are encountered in the field. Author

N92-14573 Deutscher Wetterdienst, Hamburg (Germany, F.R.). Meteorologisches Observatorium.
RESPONSE LEVEL OF PRECIPITATION SENSORS Final Report [ANSPRECHVERHALTEN VON NIEDERSCHLAGSSENSOREN]
P. Winkler 1991 71 p In GERMAN
(Contract BMFT-07431018)
(ETN-92-90311) Avail: Deutscher Wetterdienst, 2000 Hamburg, Fed. Republic of Germany

Fourteen different precipitation sensors were examined with regard to their response level. Response frequency was determined in field tests for the intensities occurring at the beginning of the rain. The response level was also determined in laboratory, using an automatically controlled sprinkling chamber. The sensors showed very different response levels. Measurements carried out in outdoor conditions and in the laboratory gave comparable results. The response level depended on structural shape, materials used, operational principle, heating type, and also partly on the rain droplet size distribution and the electric conductibility of rain water. It was shown that the sparking distance and the wetting up of electrodes and of the insulating material had an essential function. Constant-temperature heating proved more favorable than other heating methods. ESA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-14574# Miami Univ., FL. School of Marine and Atmospheric Science.
SATELLITE REMOTE SENSING OF LARGE SCALE OCEAN TRANSIENTS Final Report, 1 Oct. 1986 - 31 Jan. 1991
Otis Brown and Robert Evans 12 Aug. 1991 4 p
(Contract N00014-87-G-0116)
(AD-A241122) Avail: NTIS HC/MF A01 CSCL 08/3

The objectives of this project included study of transient behavior of western boundary currents and associated eddy structures, frontal processes, and their response to atmospheric forcing as observed by satellite remote sensing techniques. Attainment of these objectives required development of quantitative assimilation methods for satellite data on both large and small scales supported by suitable tools which yield timely access to calibrated, navigated satellite observations. Efforts focused on obtaining a multi-year time series of high resolution NOAA AVHRR retrievals for the Brazil Current/Malvinas (Falklands) Confluence, analysis of these data, implementation of a GEOSAT altimetric measurement processing and analysis system and preliminary analysis of a year time series for the South Atlantic and Western Indian Oceans, and implementation of remote AVHRR LAC collection for the Western Indian Ocean region and operation of the global retrieval capability using the DOD/ONR furnished satellite receiving systems. GRA

N92-14575 Royal Netherlands Meteorological Inst., De Bilt. Div. of Oceanographic Research.
THE IMPLEMENTATION OF THE WAQUA/CSM-16 MODEL FOR REAL TIME STORM SURGE FORECASTING
Johannes Weitze deVries Mar. 1991 42 p
(KNMI-TR-131; ISSN-0169-1708; ETN-92-90688) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

A model for the prediction of the water levels in the North Sea, named WAQUA, is presented. The purpose of the model is to facilitate the interpretation of meteorological data and to get a better view of the present and future state of the atmosphere and the sea. The WAQUA system was developed for two dimensional hydrodynamic and water quality simulations of well fixed estuaries and coastal seas. It solves the well known shallow water equations, in which viscosity is neglected, and is implemented with Kalman filters. The WAQUA model is driven by the 10 m winds from the limited area atmospheric circulation model, which are converted to friction velocities with a quadratic drag relation. The WAQUA system also produces depth average current in the North Sea. From the first results, it seems that the translation of the water levels just outside the Weddensee to the coastal stations Harlingen in Delfzyl, hardly gives better forecasts than these stations in the model itself. ESA

N92-14576# Technische Univ., Delft (Netherlands). Dept. of Mathematical and Physical Geodesy.
MONITORING SEA LEVEL RISE
Xu Peiliang 1990 60 p
(Contract MD277)
(Rept-90-1; ETN-92-90421) Avail: NTIS HC/MF A04

The GLOSS (Global Sea Level Observing System) network and its various engineering applications is introduced. Several causes of sea level rise are summarized. Several computing methods of monthly and annual mean sea level and their error sources, based on the observation types of stilling well and pressure gauges, are summarized. Because the present prediction of sea level rise is unreliable and very uncertain, a monitoring system must be started immediately. An integration concept of sea-land, land-land and sea-sea for this system is developed. The purpose of the sea-land part is to supply sea level measurements of high quality. The land-land part is to connect all local tide gauge stations into a regional and global network and accurately detect the crustal movements. The sea-sea part is to provide information on ocean dynamics. Other related problems are investigated. ESA

51 LIFE SCIENCES (GENERAL)

N92-14577# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
22 Oct. 1991 54 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-91-019) Avail: NTIS HC/MF A04

Abstracts of Soviet publications in various areas of the life sciences are presented. The areas covered include: biochemistry, biophysics, pharmacology, toxicology, and virology. K.S.

N92-14578# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
28 Oct. 1991 65 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-91-020) Avail: NTIS HC/MF A04

Translations are presented from several Russian technical publications. They are divided under several general topics, including the following: agricultural science; biochemistry; biophysics; epidemiology; genetics; immunology; laser bioeffects; medicine; microbiology; molecular biology; pharmacology, toxicology; physiology; public health; radiation biology; and virology. E.R.

N92-14579# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
13 Nov. 1991 31 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-91-021) Avail: NTIS HC/MF A03

Translations are presented of articles from several Russian publications. They are headed under several general topics including the following: agricultural science; biochemistry; biotechnology; genetics; medicine; microbiology; pharmacology, toxicology; physiology; and virology. E.R.

N92-14580# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES

19 Nov. 1991 49 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-91-022) Avail: NTIS HC/MF A03
Abstracts of Soviet publications in various areas of the life sciences are presented. The areas covered include: military medicine and public health. K.S.

N92-14581# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
26 Nov. 1991 62 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-91-023) Avail: NTIS HC/MF A04
Abstracts of Soviet publications in various areas of the life sciences are presented. The areas covered include: aerospace medicine, epidemiology, and public health. K.S.

N92-14582# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
29 Nov. 1991 47 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-91-024) Avail: NTIS HC/MF A03
Abstracts of Soviet publications in various areas of the life sciences are presented. The areas covered include: laser bioeffects, medicine, microbiology, and radiation biology. K.S.

N92-14583# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTROMAGNETIC FIELD EFFECTS ON CELLS OF THE IMMUNE SYSTEM: THE ROLE OF CALCIUM SIGNALLING
J. Walleczek Jul. 1991 45 p Presented at the 75th Annual Meeting of the Federation of American Societies for Experimental Biology (FASEB), Atlanta, GA, 21-25 Apr. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000852; LBL-31097; CONF-9104107-1) Avail: NTIS HC/MF A03
During the past decade considerable evidence has accumulated demonstrating the exposures of cells of the immune system to relatively weak extremely low frequency (ELF) electromagnetic fields (less than 300 Hz) can elicit cellular changes which might be relevant to in-vivo immune activity. However, knowledge about the underlying biological mechanisms by which weak fields induce cellular changes is still very limited. It is generally believed that the cell membrane and Ca(2+) regulated activity is involved in bioactive ELF field-coupling to living systems. This article begins with a short review of the current state of knowledge concerning the effects of nonthermal levels of ELF electromagnetic fields on the biochemistry and activity of immune cells, and then closely examines new results which suggest a role for Ca(2+) in the induction of these cellular field effects. Based on these findings it is proposed that membrane-mediated Ca(2+) signalling processes are involved in the mediation of field effects on the immune system. DOE

N92-14477# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.
THE BIOTECHNOLOGY OF CULTIVATING DUNALIELLA RICH IN BETA CAROTENE: FROM BASIC RESEARCH TO INDUSTRIAL PRODUCTION
Mordhay Avron *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 138-139 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

N92-14478# Midwest Research Inst., Golden, CO. Biotechnology Research Branch.
PRODUCTION POTENTIAL OF BIOCHEMICALS FROM ALGAE AND OTHER BIOTECHNOLOGICAL INNOVATIONS ENABLED BY HIGHER SOLAR CONCENTRATION
Lewis M. Brown *In* NAS-NRC, Potential Applications of Concentrated Solar Energy 1991 p 140 (For primary document see N92-14445 05-44)
Avail: NTIS HC/MF A08

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-14584# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Images.
PATTERN RECOGNITION IN PULMONARY COMPUTERIZED TOMOGRAPHY IMAGES USING MARKOVIAN MODELING
Francoise Preteux, Michel Moubarak, and Philippe Grenier (Hopital Salpetriere, Paris, France) Mar. 1991 17 p Presented at the International Society for Optical Engineering and the Society for Imaging Science and Technology Symposium on Electronic Imaging Science and Technology, San Jose, CA, 24 Feb. - 1 Mar. 1991 Submitted for publication
(TELECOM-Paris-91-C-002; ISSN-0751-1337; ETN-91-90116)
Copyright Avail: NTIS HC/MF A03
A nonstationary Markovian model with deterministic relaxation for segmenting the hyperattenuated areas in pulmonary computerized tomography is proposed. This contribution lies in the definition of a local energy as the weighted combination of four components: density function; the Geman-Graffigne gradient function; the local maxima function concerning cliques of order one; and the attraction-repulsion function as an Ising model dealing with cliques of order two. This potential is deduced from preprocessing and a priori knowledge. Spatial interactions are modeled on a hexagonal lattice. The six connectivity neighborhood system is defined by morphological dilations. An important aspect of the model is that it considers, in addition to the two classes normally used (hyperattenuated and nonhyperattenuated), a third class for nonidentifiable pixels. Results of this automatic segmentation perfectly match the areas interactively selected by the radiologists. ESA

N92-14585# International Centre for Theoretical Physics, Trieste (Italy).
THE EFFECT OF ULTRASOUND ON ARTERIAL BLOOD FLOW. PART 1: STEADY FULLY DEVELOPED FLOW
A. R. Bestman Dec. 1990 8 p
(DE91-635323; IC-90/447) Avail: NTIS HC/MF A02
The paper models the effects of ultrasound heating of the tissues and the resultant perturbation on blood flow in the arteries and veins. It is assumed that the blood vessel is rigid and the undisturbed flow is fully developed. Acoustical perturbation on this Poiseuille flow, for the general three-dimensional flow with heat transfer in an infinitely long pipe is considered. Closed form analytical solutions are obtained to the problem. It is discovered that the effects of the ultrasound heating are concentrated at the walls of the blood vessels. DOE

N92-14586*# Wright State Univ., Dayton, OH. Dept. of Pharmacology.
PHARMACOLOGICAL AND NEUROPHYSIOLOGICAL ASPECTS OF SPACE/MOTION SICKNESS Final Report, 1 Jan. 1986 - 31 Dec. 1991
James B. Lucot and George H. Crampton 30 Dec. 1991 23 p
(Contract NCC2-229)
(NASA-CR-189521; NAS 1.26:189521) Avail: NTIS HC/MF A03 CSCL 06P
A motorized motion testing device modeled after a Ferris wheel was constructed to perform motion sickness tests on cats. Details of the testing are presented, and some of the topics covered include the following: xylazine-induced emesis; analysis of the constituents of the cerebrospinal fluid (CSF) during motion sickness; evaluation of serotonin-1A (5-HT sub 1A) agonists; other 5HT receptors; antimuscarinic mechanisms; and antihistaminergic mechanisms. The ability of the following drugs to reduce motion sickness in the cats was examined: amphetamines, adenosinergic

drugs, opioid antagonists, peptides, cannabinoids, cognitive enhancers (nootropics), dextromethorphan/sigma ligands, scopolamine, and diphenhydramine. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-14587# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE MATCHING OF DOUBLY AMBIGUOUS STEREOGRAMS
Daphna Weinshall Jul. 1991 23 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A241251; AI-M-1312) Avail: NTIS HC/MF A03 CSCL 12/2

I have previously described psychophysical experiments that involved the perception of many transparent layers, corresponding to multiple matching, in doubly ambiguous random dot stereograms. Additional experiments are described in the first part of this paper. In one experiment, subjects were required to report the density of dots on each transparent layer. In another experiment, the minimal density of dots on each layer, which is required for the subjects to perceive it as a distinct transparent layer, was measured. The difficulties encountered by stereo matching algorithms, when applied to doubly ambiguous stereograms, are also described. Algorithms that can be modified to perform consistently with human perception, and the constraints imposed on their parameters by human perception, are discussed. GRA

N92-14588# Dayton Univ., OH.
TRANSFER OF TRAINING FROM A RADAR INTERCEPT PART-TASK TRAINER TO AN F-16 FLIGHT SIMULATOR Final Technical Report, Mar. 1988 - Mar. 1991
Bernell J. Edwards and David C. Hubbard Aug. 1991 13 p
(Contract F33615-90-C-0005)
(AD-A241493) Avail: NTIS HC/MF A03 CSCL 05/6

Fifty student pilots participated in an experiment to determine the training effectiveness of an experimental air intercept part-task trainer. F-16 student pilots with no prior knowledge of air intercepts were randomly assigned as subjects either to an experimental group or to a control group. Experimental subjects (n=25) learned to perform air intercept basic skills in the Air Intercept Trainer (AIT), followed by training on intercepts in an F-16 Operational Flight Trainer (OFT). Control group subjects (n=25) received only standard academic training on air intercepts prior to training in the OFT. Instructors, who were not informed of the assignment of subjects to groups during the experiment, rated student performance during OFT training using a 5-point scale (0-4) in five skill categories: (1) radar use, (2) aircraft control, (3) intercept geometry, (4) situational awareness, and (5) overall execution of intercepts. The number of trial intercepts required by each student to achieve a proficiency rating of 3 (overall execution of intercepts) was recorded. Mean composite ratings of the AIT-trained subjects were found to be higher than those of non-AIT-trained subjects in all five skill categories. These differences were statistically significant for all but the first category (radar use). The percentage of AIT-trained subjects who achieved Level 3 proficiency ratings on basic and advanced intercepts in the OFT was significantly higher than that non-AIT-trained subjects on three out of four types of intercepts. These findings provide evidence that the AIT can improve training of basic intercepts compared to standard syllabus procedures alone. GRA

N92-14589# Dayton Univ., OH.
CONTRACTOR-SUPPORTED AIRCREW TRAINING SYSTEMS: ISSUES AND LESSONS LEARNED Final Report, Jan. 1989 - Feb. 1991
Marty R. Rockway and Robert T. Nullmeyer Aug. 1991 44 p
(Contract F33615-90-C-0005)
(AD-A241590; AL-TR-1991-0031) Avail: NTIS HC/MF A03 CSCL 05/9

The current trend within the Air Force is to design aircrew training programs as total integrated systems rather than as collections of courses or blocks of instruction. This trend has been coupled with a concurrent shift to contracting-out the design, delivery, and support of aircrew training. These changes have introduced a new set of technical and management issues which impact the design, development, evaluation, and operation of aircrew training programs. AL/HRA is conducting research and development to address several of these issues in order to provide principles, procedures, and user-oriented guidelines to support Air Force acquisition and operational training agencies. In this review, data were collected from several Air Force aircrew training system (ATS) programs to identify the major issues and lessons learned during the design, development, evaluation, and operation of these systems. In addition, data were also obtained from selected Navy and allied forces aircrew training systems to serve as a cross-check on the generality of the Air Force findings. The major findings of the ATS review are summarized, and key issues and lessons learned are identified and discussed. GRA

N92-14590# Dayton Univ., OH.
B-52 AND KC-135 MISSION QUALIFICATION AND CONTINUATION TRAINING: A REVIEW AND ANALYSIS Final Report, Apr. 1987 - Apr. 1991
Philip D. Bruce and Thomas H. Killion Aug. 1991 38 p
(Contract F33615-87-C-0012)
(AD-A241591; AL-TR-1991-0010) Avail: NTIS HC/MF A03 CSCL 05/9

This report documents the findings of a review and analysis of mission qualification and continuation training for B-52 and KC-135 aircrews. The effort addressed unit perceptions of the capabilities of formal school graduates, training requirements, training resources, aircrew and training system evaluation, and management. In addition to providing extensive descriptive and analytical information about the operation of a large aircrew training system, the report includes as major findings: (1) the need to clarify initial qualification training requirements; (2) evidence of widespread support for recent initiatives regarding training of tactics and warfighting skills, and a corresponding need for increased attention to the design and implementation of this training; (3) the necessity for effective and efficient allocation of training resources across the continuum of training; (4) the need to develop improved methods for evaluating individuals and aircrews--especially in terms of combat skills-and the training system as a whole; and (5) the need for an improved mechanism to manage the training requirements process throughout the training system. Recommendations are provided for research and development in several key areas. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-14591*# Spectra Research Systems, Inc., Huntsville, AL.
INITIAL ASSESSMENTS OF LIFE SUPPORT TECHNOLOGY EVOLUTION AND ADVANCED SENSOR REQUIREMENTS, VOLUME 2, APPENDIX A
Edward E. Montgomery 3 Sep. 1991 53 p
(Contract NAS8-38781)
(NASA-CR-184248; NAS 1.26:184248;
SRS/STG-TR92-01-Vol-2-App-A) Avail: NTIS HC/MF A04 CSCL 06K

The primary issues studied were how the transition from a physical/chemical (P/C) to hybrid to a Closed Ecological Life Support System (CELSS) could be achieved, what sensors and

monitors are needed for a P/C -CELSS hybrid system, and how a CELSS could be automated and what controls would be needed to do so. Author

N92-14592*# Spectra Research Systems, Inc., Huntsville, AL.
APPENDICES B THRU F, VOLUME 3
3 Sep. 1991 164 p
(Contract NAS8-38781)
(NASA-CR-184249; NAS 1.26:184249; SRS/STG-TR92-01-Vol-3)
Avail: NTIS HC/MF A08 CSCL 06K

The purpose of this investigation was to determine if the intermodule ventilation (IMV) systems and water distribution systems of Space Station Freedom (SSF) modules and nodes should be connected as they are interfaced with those already in operation. It was concluded that the AC configuration and attached LAB and HAB modules and nodes should be interconnected. The H2O circuits should also be interconnected. Interconnecting the air and water provides flexibility of operation and safety comparable to the Assembly Complete (AC) configuration. This requires only only that valves and ducts be provided in the AC nodes. The AC node interfaces should also be scarred to provide for water transfer across these interfaces. Penalties for not connecting the Intermodular Ventilation (IMV) system and water circuits include an additional AR unit, possible increased water storage requirements, and considerable reduction in crew flexibility. Author

N92-14593*# Spectra Research Systems, Inc., Huntsville, AL.
ADVANCED INSTRUMENTATION: TECHNOLOGY DATABASE ENHANCEMENT, VOLUME 4, APPENDIX G
3 Sep. 1991 225 p
(Contract NAS8-38781)
(NASA-CR-184250; NAS 1.26:184250;
SRS/STG-TR92-01-Vol-4-App-G) Avail: NTIS HC/MF A10
CSCL 06K

The purpose of this task was to add to the McDonnell Douglas Space Systems Company's Sensors Database, including providing additional information on the instruments and sensors applicable to physical/chemical Environmental Control and Life Support System (P/C ECLSS) or Closed Ecological Life Support System (CELSS) which were not previously included. The Sensors Database was reviewed in order to determine the types of data required, define the data categories, and develop an understanding of the data record structure. An assessment of the MDSSC Sensors Database identified limitations and problems in the database. Guidelines and solutions were developed to address these limitations and problems in order that the requirements of the task could be fulfilled. Author

N92-14594*# Spectra Research Systems, Inc., Huntsville, AL.
CLEAN ROOM SURVEY AND ASSESSMENT, VOLUME 5, APPENDIX H
3 Sep. 1991 110 p
(Contract NAS8-38781)
(NASA-CR-184251; NAS 1.26:184251;
SRS/STG-TR92-01-Vol-5-App-H) Avail: NTIS HC/MF A06
CSCL 06K

The scope of this task is to perform a comparative analysis of the various Environmental Control Life Support System (ECLSS) options for different growth scenarios. The Space Station Freedom ECLSS design and existing ground-based clean room facilities are used as a baseline for comparison. Specifically addressed here are the ground based clean room facilities at the Marshall Space Flight Center (MSFC). Given here is an evaluation of the facilities, equipment, technologies, and procedures used to maintain specified environments in typical aerospace industrial areas. Twenty-five specific clean rooms are evaluated. The objectives were to collect, compare, and catalog data for each specified facility in the areas of engineering and design, construction materials, work stations, contamination control, particulate elimination, entry systems, and instrumentation, and to make recommendations concerning enhancements required to assure an efficient and orderly evolution of MSFC clean room environmental control facilities. Author

N92-14595*# Spectra Research Systems, Inc., Huntsville, AL.
ADVANCED LIFE SUPPORT STUDY Final Report
3 Sep. 1991 46 p
(Contract NAS8-38781)
(NASA-CR-184247; NAS 1.26:184247; SRS/STG-TR92-01)
Avail: NTIS HC/MF A03 CSCL 06K

Summary reports on each of the eight tasks undertaken by this contract are given. Discussed here is an evaluation of a Closed Ecological Life Support System (CELSS), including modeling and analysis of Physical/Chemical Closed Loop Life Support (P/C CLLS); the Environmental Control and Life Support Systems (ECLSS) evolution - Intermodule Ventilation study; advanced technologies interface requirements relative to ECLSS; an ECLSS resupply analysis; the ECLSS module addition relocation systems engineering analysis; an ECLSS cost/benefit analysis to identify rack-level interface requirements of the alternate technologies evaluated in the ventilation study, with a comparison of these with the rack level interface requirements for the baseline technologies; advanced instrumentation - technology database enhancement; and a clean room survey and assessment of various ECLSS evaluation options for different growth scenarios. Author

N92-14596# Joint FAO/WHO Codex Alimentarius Commission, Rome (Italy).
CODEX GENERAL STANDARD FOR IRRADIATED FOODS AND RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR THE OPERATION OF RADIATION FACILITIES USED FOR THE TREATMENT OF FOODS
Jun. 1990 22 p
(DE91-632213; AECS/IB-6) Avail: NTIS HC/MF A03

The Food and Agricultural Organization/World Health Organization (FAO/WHO) Codex Alimentarius Commission was established to implement the Joint FAO/WHO Food Standards Program. The purpose of this program is to protect the health of consumers and to ensure fair practices in the food trade. At its 15th session, held in July 1983, the Commission adopted a Codex General Standard for Irradiated Foods and a recommended international code of practice for the operation of radiation facilities used for the treatment of foods. This standard takes into account the recommendations and conclusions of the Joint FAO/IAEA/WHO Expert Committees convened to evaluate all available data concerning the various aspects of food irradiation. This standard refers only to those aspects which relate to the processing of foods by ionizing energy. The standard recognizes that the process of food irradiation has been established as safe for general application to an overall average level of absorbed dose of 10 KGy. The latter value shold not be regarded as a toxicological upper limit above which irradiated foods become unsafe; it is simply the level at or below which safety has been established. The standard provides certain mandatory provisions concerning the facilities used and for the control of the process in the irradiation plants. The present standard requires that shipping documents accompanying irradiated foods moving in trade should indicate the fact of irradiation. The labelling of prepackaged irradiated foods intended for direct sale to the consumer is not covered in this standard. DOE

N92-14597# Anacapa Sciences, Inc., Fort Rucker, AL.
HUMAN FACTORS RESEARCH IN AIRCREW PERFORMANCE AND TRAINING: 1990 ANNUAL SUMMARY REPORT Interim Report, Oct. 1989 - Oct. 1990
D. M. McAnulty Jun. 1991 118 p
(Contract MDA903-87-C-0523; DA Proj. 2Q1-62785-A-790; DA Proj. 2Q2-63007-A-792)
(AD-A241134; ASI-690-339-90; ARI-TR-930) Avail: NTIS HC/MF A06 CSCL 23/2

This report presents summary descriptions of the research projects performed by the contractor. Anacapa personnel worked on 21 research projects and one technical advisory service in emerging aviation systems design, manpower and personnel programs, aviator training, and aviation safety research. The report also describes two research projects that were conducted under subcontract to Anacapa Sciences. The summary description for

each project and the technical advisory service contains (1) a background section that describes the rationale for the project and specifies the research objectives; (2) a research approach section that describes the tasks and activities required to meet the project objectives; (3) a work completed section that may include research findings or, in the case of developmental activities, a description of the research products; and (4) a project status section that describes the projections for future research, if any.
GRA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N92-14251*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
POLYPHASE-DISCRETE FOURIER TRANSFORM SPECTRUM ANALYSIS FOR THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE SKY SURVEY
G. A. Zimmerman and S. Gulkis *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 141-154 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 06C

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N92-14598*# Computer Sciences Corp., Hampton, VA.
ANALYSIS OF OBJECTS IN BINARY IMAGES M.S. Thesis - Old Dominion Univ.
Desiree M. Leonard Washington NASA Dec. 1991 76 p (Contract NAS1-19038)
(NASA-CR-4420; NAS 1.26:4420) Avail: NTIS HC/MF A05 CSCL 12A

Digital image processing techniques are typically used to produce improved digital images through the application of successive enhancement techniques to a given image or to generate quantitative data about the objects within that image. In support of and to assist researchers in a wide range of disciplines, e.g., interferometry, heavy rain effects on aerodynamics, and structure recognition research, it is often desirable to count objects in an image and compute their geometric properties. Therefore, an image analysis application package, focusing on a subset of image analysis techniques used for object recognition in binary images, was developed. This report describes the techniques and algorithms utilized in three main phases of the application and are categorized as: image segmentation, object recognition, and quantitative analysis. Appendices provide supplemental formulas for the algorithms employed as well as examples and results from the various image segmentation techniques and the object recognition algorithm implemented. Author

N92-14599# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
HISTORY OF CONSTRUCTIVISM IN THE TWENTIETH CENTURY
A. S. Troelstra Apr. 1991 34 p
(ITLI-ML-91-05; ISSN-0924-2090; ETN-92-90430) Avail: NTIS HC/MF A03

The history of constructivism is surveyed with more space devoted to early development (up to circa 1965) than to work of the last few decades because of the latter's technical and complicated nature. Subjects discussed include finitism, predicatism and semi intuitionism, Brouwerian intuitionism, logic and arithmetic, intuitionistic analysis and stronger theories, constructive recursive mathematics, and Bishop's constructivism. ESA

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-14600# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
AN ENGINEERING APPROACH TO ODP SYSTEMS DESIGN
Marten vanSinderen and Jeroen Schot Jun. 1991 25 p Presented at the International IFIP Workshop on Open Distributed Processing, Berlin, Germany, 8-11 Oct. 1991
(Memo-INF-91-49; TIOS-91/017; ISSN-0923-1714; ETN-92-90364) Avail: NTIS HC/MF A03

Openness, reliability, and easy integration are the major conditions which determine the success and widespread use of distributed processing applications. Standardization efforts towards an open distributed processing (ODP) reference model are underway to provide the basis for fulfilling these conditions. A design engineering approach which exploits the application of several ODP concepts and so facilitates the stepwise and correct development of ODP systems is presented. A simple design case to demonstrate the approach is discussed. The design case also illustrated the use of a Formal Description Technique (FDT) along the design trajectory. Some observations on FDT based design concepts which are relevant in the ODP domain are discussed.
ESA

N92-14601# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
NEXT GENERATION AUTHORING SYSTEMS: INTEGRATION OF MULTIPLE METHODOLOGIES AND TOOLS
Charles vanderMast and Jukka Rantanen (Technical Research Centre of Finland, Helsinki.) 1990 17 p
(Rept-90-80; ISSN-0922-5641; ETN-92-90369) Copyright Avail: NTIS HC/MF A03

The methodologies and tools for developing Computer Based Training (CBT) courseware, user interfaces, hypermedia databases, and knowledge based systems have during the past years evolved mostly as isolated disciplines. The increasing availability of easy to use tools on graphical workstations and personal computers is breaking the borders and barriers between these disciplines. An attempt to integrate these different disciplines into a conception of the next generation authoring system is presented. The integration of the powers of these various disciplines may amplify the development of multimedia couseware to a greater effect than continuing the separate lines of development of methodologies and tools. The advent of the 'HyperCard and VisiCalc' for courseware authoring may lead to the introduction of real authoring systems to replace the still commonplace authoring languages.
ESA

N92-14602# National Science Foundation, Washington, DC. Div. of Microelectronic Information Processing Systems.
SUMMARY OF AWARDS, FISCAL YEAR 1990
1990 71 p
(NSF-90-132) Avail: NTIS HC/MF A04

The Microelectronic Information Processing Systems Division (MIPS) supports research on novel computing and information processing systems including signal processing. Emphasis is on experimental research, technology-related research and particularly the critical link between conceptualization and realization for integrated systems. Technologies include very large scale integration (VLSI), ultra large scale integration (ULSI), optical, optoelectronic,inter-connection and other emerging technologies. The focus is on research pertaining to hardware systems and their supporting software, including experimental research involving these new systems; infrastructures, environments, tools, methodologies and services for rapid systems prototyping; design methodologies and tools; technology-driven and application-driven systems architectures; and fabrication and testing of systems. For

signal-processing systems, research on algorithms and architectures relating to these new technologies that have promise for real-time computing is emphasized. The purpose of this Summary of Awards for the MIPS Division is to provide the scientific and engineering communities with a summary of those grants awarded in Fiscal Year 1990. Only those projects funded using Fiscal Year 1990 dollars are listed, and hence multi-year awards initiated prior to Fiscal Year 1990 are not listed. Similar areas of research are grouped together for reader convenience. Grantee institutions and principal investigators are identified first. Award identification numbers, award amounts, and award durations are enumerated after the individual project titles. Within each category, the awards are listed alphabetically by state and institution.

Author

N92-14603*# Utrecht State Univ. (Netherlands). Dept. of Computer Science.

EVALUATION OF THE CEDAR MEMORY SYSTEM: CONFIGURATION OF 16 BY 16

K. Gallivan, W. Jalby (Rennes Univ., France), and H. Wijshoff Jun. 1991 42 p Sponsored in part by Cray Research Inst. and Allian Computer Systems

(Contracts NCC2-559; DE-FG02-85ER-25001; NSF 89-20891) (NASA-CR-189535; NAS 1.26:189535; RUU-CS-91-16; ISSN-0924-3275; ETN-92-90480) Avail: NTIS HC/MF A03 CSCL 09B

Some basic results on the performance of the Cedar multiprocessor system are presented. Empirical results on the 16 processor 16 memory bank system configuration, which show the behavior of the Cedar system under different modes of operation are presented. ESA

N92-14031# National Research Council of Canada, Ottawa (Ontario). Flight Research Lab.

A HARD REAL-TIME OPERATING SYSTEM FOR AIRBORNE SCIENTIFIC EXPERIMENTS

J. E. Jordan *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 123-126 (For primary document see N92-14009 05-04)

Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-14604*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

Ada AND SOFTWARE MANAGEMENT IN NASA: ASSESSMENT AND RECOMMENDATIONS

Mar. 1989 70 p

(NASA-TM-103298; NAS 1.15:103298) Avail: NTIS HC/MF A04 CSCL 09B

Recent NASA missions have required software systems that are larger, more complex, and more critical than NASA software systems of the past. The Ada programming language and the software methods and support environments associated with it are seen as potential breakthroughs in meeting NASA's software requirements. The findings of a study by the Ada and Software Management Assessment Working Group (ASMAWG) are presented. The study was chartered to perform three tasks: (1) assess the agency's ongoing and planned Ada activities; (2) assess the infrastructure (standards, policies, and internal organizations) supporting software management and the Ada activities; and (3) present an Ada implementation and use strategy appropriate for NASA over the next 5 years. Author

N92-14605# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

PROJECTED QUASI-NEWTON UPDATES

Y. F. Hu and C. Storey May 1991 26 p Revised

(MATHS-Rept-A-144; MATHS-Rept-A-135; ETN-91-99889) Avail: NTIS HC/MF A03

A projected version of a Broyden Fletcher Goldfarb Shanno (BFGS) quasi Newton method of optimization is derived by minimizing an appopriate Frobenius norm. A number of different implementations of the method are compared with the BFGS method on a large number of standard test functions. One of the implementations is found to be slightly superior to BFGS overall, but it demonstrates marked superiority on some of the test problems. ESA

N92-14606 Politecnico di Milano (Italy). Dipt. di Elettronica.

DEFINITION OF REUSABLE CONCURRENT SOFTWARE COMPONENTS

Stefan CrespiReghizzi, G. GallideParatesi, and S. Genolini (TXT Ingegneria Informatica S.p.A., Milan, Italy) 1990 24 p Sponsored in part by Commission of the European Communities; MURST; and CNR

(Rept-90-066; ETN-91-90247) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

In Object Oriented (OO) languages with active objects, a constraint (or behavior) on method activations (e.g., reader writer with writer priority) is needed to avoid inconsistencies and to meet performance requirements. If the constraint is part of class definition, the class population grows by the product of the number of behaviors. Extending previous work on separate specifications of functional and behavioral aspects of a class, behavioral (b) inheritance provides a behavior to a sequential class. Combination of b inheritance and inheritance is discussed, and a deontic logic notation for specifying behavior is extended to more complex constraints and for greater reuse of similar components. The proposal is formalized by extended Petri nets and the translation into a concurrent language is outlined. ESA

N92-14607*# Mississippi State Univ., Mississippi State. Engineering Research Center.

ENHANCEMENT OF SURFACE DEFINITION AND GRIDDING IN THE EAGLE CODE Final Technical Report, Aug. 1989 - Sep. 1991

Joe F. Thompson 27 Nov. 1991 95 p

(Grant NAG1-1061)

(NASA-CR-189445; NAS 1.26:189445) Avail: NTIS HC/MF A05 CSCL 09B

Algorithms for smoothing of curves and surfaces for the EAGLE grid generation program are presented. The method uses an existing automated technique which detects undesirable geometric characteristics by using a local fairness criterion. The geometry entity is then smoothed by repeated removal and insertion of spline knots in the vicinity of the geometric irregularity. The smoothing algorithm is formulated for use with curves in Beta spline form and tensor product B-spline surfaces. Author

N92-14608# KDT Industries, Inc., Austin, TX.

UNIFIED LIFE CYCLE ENGINEERING (ULCE) DESIGN SYSTEM Final Report, Feb. - Aug. 1990

Patrick R. Flanagan Aug. 1991 77 p

(Contract F33615-89-C-5733)

(AD-A241039; WL-TR-91-8045) Avail: NTIS HC/MF A05 CSCL 12/5

This report describes Phase 1 of a project to develop a computer program to improve the efficiency of the engineering design process. The program will integrate Feature Based Modeling with Concurrent Engineering to facilitate the development of life cycle analysis models. The purpose of the program is to reduce data management and computer program interface coding requirements on engineering designers. The proposed program combined an Object Oriented Database, Expert System, Computer Aided Design (CAD) system, and computer model integration tool to create friendly, graphically oriented user interfaces that allow multiple

representations of design data. This program also allows designers to develop interfaces between the design database and computer analysis models without writing computer code. The project resulted in four primary products: (1) a methodology and architecture; (2) a limited proof of concept computer model; (3) a feature based life cycle model of a microwave switch; and (4) a Phase 2 plan. GRA

N92-14609# California Univ., Berkeley. Lawrence Berkeley Lab.
GAMUT: A COMPUTER CODE FOR (GAMMA)-RAY ENERGY AND INTENSITY ANALYSIS
R. B. Firestone May 1991 27 p
(Contract DE-AC03-76SF-00098)
(DE92-000691; LBL-26024) Avail: NTIS HC/MF A03

GAMUT is a computer code to analyze gamma ray energies and intensities. It does a linear least-squares fit of measured gamma ray energies from one or more experiments to the level scheme. GAMUT also performs a non-linear least-squares analysis of branching intensities. For both energy and intensity data, a statistical Chi-square analysis is performed with an iterative uncertainty adjustment. The uncertainties of outlying measured values and sets of measurements with x(exp 2)/f greater than 1 are increased, and the calculation is repeated until the uncertainties are consistent with the fitted values. GAMUT accepts input from standard or special-format ENSDF data sets. The special-format ENSDF data sets were designed to permit analysis of more than one set of measurements associated with a single ENSDF data set. GAMUT prepares a standard ENSDF format output data set containing the adjusted values. If more than one input ENSDF data set is provided, GAMUT creates an ADOPTED LEVELS, GAMMAS data set containing the adjusted level and gamma ray energies and branching intensities from each level normalized to 100 for the strongest gamma ray. GAMUT also provides a summary of the results and an extensive log of the iterative analysis. GAMUT is interactive, prompting the user for input and output file names and for default calculation options. This version of GAMUT has adjustable dimensions so that any maximum number of data sets, levels, and gamma rays can be established at the time of implementation. DOE

N92-14610# Sandia National Labs., Albuquerque, NM.
IMPROVED SELECTION IN TOTALLY MONOTONE ARRAYS
Y. Mansour, J. K. Park, and B. Schieber (International Business Machines Corp., Yorktown Heights, NY.) 1991 18 p Presented at the 11th Foundations of Software Technology and Theoretical Computer Science, New Dehli (India), 17-19 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000817; SAND-91-2039C; CONF-911257-1) Avail: NTIS HC/MF A03

This paper's main result is an O((sq. root of m lg m)(n lg n) + m lg n)-time algorithm for computing the kth smallest entry in each row of an m x n totally monotone array. (A two-dimensional A = (a(i,j)) is totally monotone if for all i sub 1 less than i sub 2 and j sub 1 less than j sup 2, a(i sub 1,j sub 1) less than a(i sub 1,j sub 2) implies a(i sub 2,j sub 1) less than a(i sub 1,j sub 2).) For large values of k (in particular, for k=(n/2)), this algorithm is significantly faster than the O(k(m+n))-time algorithm for the same problem due to Kravets and Park. An immediate consequence of this result is an O(n(exp 3/2) lg(exp 2)n)-time algorithm for computing the kth nearest neighbor of each vertex of a convex n-gon. In addition to the main result, we also give an O(n lg m)-time algorithm for computing an approximate median in each row of an m x n totally monotone array; this approximate median is an entry whose rank in its row lies between (n/4) and (3n/4) -1. DOE

N92-14611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOME PRACTICAL UNIVERSAL NOISELESS CODING TECHNIQUES, PART 3, MODULE PSI14,K+
Robert F. Rice 15 Nov. 1991 132 p
(NASA-CR-188718; NAS 1.26:188718) Avail: NTIS HC/MF A07 CSCL 09B

The algorithmic definitions, performance characterizations, and application notes for a high-performance adaptive noiseless coding module are provided. Subsets of these algorithms are currently under development in custom very large scale integration (VLSI) at three NASA centers. The generality of coding algorithms recently reported is extended. The module incorporates a powerful adaptive noiseless coder for Standard Data Sources (i.e., sources whose symbols can be represented by uncorrelated non-negative integers, where smaller integers are more likely than the larger ones). Coders can be specified to provide performance close to the data entropy over any desired dynamic range (of entropy) above 0.75 bit/sample. This is accomplished by adaptively choosing the best of many efficient variable-length coding options to use on each short block of data (e.g., 16 samples) All code options used for entropies above 1.5 bits/sample are 'Huffman Equivalent', but they require no table lookups to implement. The coding can be performed directly on data that have been preprocessed to exhibit the characteristics of a standard source. Alternatively, a built-in predictive preprocessor can be used where applicable. This built-in preprocessor includes the familiar 1-D predictor followed by a function that maps the prediction error sequences into the desired standard form. Additionally, an external prediction can be substituted if desired. A broad range of issues dealing with the interface between the coding module and the data systems it might serve are further addressed. These issues include: multidimensional prediction, archival access, sensor noise, rate control, code rate improvements outside the module, and the optimality of certain internal code options. Author

N92-14612# Sandia National Labs., Albuquerque, NM.
SHOCK WAVE CODES AT SANDIA NATIONAL LABORATORIES
J. M. McGlaun 20 Aug. 1991 33 p Presented at the 18th International Symposium on Shock Waves, Sendai, Japan, 21-26 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-017847; SAND-91-1921C; CONF-9107138-2) Avail: NTIS HC/MF A03

Sandia National Laboratories is very active in developing multi-dimensional, multi-material shock wave physics codes. One example is the state-of-the-art, three-dimensional Eulerian code CTH which is used at numerous government and university sites. CTH is being ported to both Single Instruction Multiple Data (SIMD) and Multiple Instruction Multiple Data (MIMD) massively parallel computers. The next-generation arbitrary-Lagrangian-Eulerian code RHALE is under development. This paper will discuss these codes. DOE

N92-14613# Sandia National Labs., Albuquerque, NM.
TWO-DIMENSIONAL ADAPTIVE ENHANCEMENT AND DETECTION OF LINEAR FEATURES IN NOISY IMAGES
C. D. Knittle and N. Magotra (New Mexico Univ., Albuquerque.) 1991 6 p Presented at the Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, 4-6 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000982; SAND-91-1243C; CONF-9111101-1) Avail: NTIS HC/MF A02

This paper presents results from using a novel two-dimensional adaptive filtering algorithm to enhance linear features embedded in noisy images. The algorithm is called the two-dimensional adaptive correlation enhancer (2DACE). The 2DACE algorithm is a coefficient update scheme that converges to the two-dimensional autocorrelation function of the signal or feature of interest. Since the noise statistics are nonstationary and the duration of a signal or feature can be very short, the algorithm must be capable of rapid convergence to its optimal impulse response, a requirement that 2DACE meets. After the image has been enhanced, a modified Radon transform is employed to explore the improved detectability of the linear features. DOE

N92-14614# Westinghouse Hanford Co., Richland, WA.
CDFTBL: A STATISTICAL PROGRAM FOR GENERATING CUMULATIVE DISTRIBUTION FUNCTIONS FROM DATA
P. W. Eslinger (Pacific Northwest Lab., Richland, WA.) Jun. 1991 117 p
(Contracts DE-AC06-87RL-10930; DE-AC06-76RL-01830)
(DE92-002106; WHC-EP-0418) Avail: NTIS HC/MF A06

This document describes the theory underlying the CDFTBL code and gives details for using the code. The CDFTBL code provides an automated tool for generating a statistical cumulative distribution function that describes a set of field data. The cumulative distribution function is written in the form of a table of probabilities, which can be used in a Monte Carlo computer code. A specific application, CDFTBL can be used to analyze field data collected for parameters required by the PORMC computer code. Section 2.0 discusses the mathematical basis of the code. Section 3.0 discusses the code structure. Section 4.0 describes the free-format input command language, while Section 5.0 describes in detail the commands to run the program. Section 6.0 provides example program runs, and Section 7.0 provides references. The Appendix provides a program source listing. DOE

N92-14615# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A LAST-FIT GREEDY COLORING ALGORITHM FOR INTERVAL GRAPHS
W. M. Nawijn May 1991 12 p
(MEMO-961; ISSN-0169-2690; ETN-92-90494) Avail: NTIS HC/MF A03

A greeding coloring algoritm for interval graphs that colors as many vertices as possible using k colors is discussed. Given a specific ordering of the vertices, the algorithm always tries to color a vertex with the last used color among the feasible colors. ESA

N92-14616# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SCATTERED DATA INTERPOLATION BY BIVARIATE QUADRATIC AND CUBIC SPLINES: DESCRIPTION OF PROGRAMS
Bernd Mulansky (Technische Univ., Dresden, German D.R.) Jun. 1991 9 p Sponsored in part by Netherlands Organization for the Advancement of Research
(MEMO-977; ISSN-0169-2690; ETN-92-90509) Avail: NTIS HC/MF A02

A short overview on the HP PASCAL software is given. The implementations realize several methods of scattered data interpolation by bivariate quadratic and cubic splines with special emphasis on shape preserving. ESA

N92-14617# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A HYPERELLIPTIC DIOPHANTINE EQUATION RELATED TO IMAGINARY QUADRATIC NUMBER FIELDS WITH CLASS NUMBER 2
B. M. M. deWeger Jun. 1991 20 p
(MEMO-978; ISSN-0169-2690; ETN-92-90510) Avail: NTIS HC/MF A03

It is proved that (X,Y) (2, +/-3), (5, +/-36) are the only solutions of the diophantine equation, X(exp 6) + 10X(exp 3) - 27 = 13Y(exp 2), as was conjectured by Antoniadis. This yields a new proof of the fact that the only fields Q(square root of -13p) with (p,6) = 1 having class number 2 are those with p = 7,31. The mentioned diophantine equation is reduced to a cubic Thue equation with coefficients in Q(square root of 13), which is then solved by the theory of linear forms in logarithms and computational diophantine approximation techniques. Some conjectures on related Thue recurrence equations are formulated. ESA

N92-14618# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
COMPILER GENERATOR LIBRARY REFERENCE MANUAL
Wim Schepers and Joos Schaap-Kruseman 10 Feb. 1991 95 p
(Memo-INF-91-08; ISSN-0923-1714; ETN-92-90512) Avail: NTIS HC/MF A05

A reference manual for the Compiler Generator Library (CGL), which is aimed at aiding the compiler generator builder or designer is presented. CGL is divided into modules which group routines depending on functionality. The library was developed from attributed parser generators. ESA

N92-14619# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ALGORITHMS FOR TOPOLOGICAL PARTITIONING OF PROGRAMMED LOGIC ARRAYS, UNDER FLOORPLAN, AND DELAY CONSTRAINTS
A. J. W. M. tenBerg Jun. 1991 12 p
(Memo-INF-91-43; ISSN-0924-3755; ETN-92-90513) Avail: NTIS HC/MF A03

An algorithm for the topological partitioning of programmed logic array's (PLA's) under environment constraints is presented. Topological partitioning of PLA's can serve more purposes than the common size reduction. From a design integration point of view, issues from its environment as maximal delay and floorplan shape are of higher importance than pure size reduction. Therefore, the partitioning algorithm can handle a delay limit and can deliver a solution within a given floorplan shape or aspect ratio. Built-in heuristics minimize area losses in case a delay limit or a floorplan shape restriction are used. Partitioning for a restricted floorplan is shown to be more effective than floorplanning with a size minimal partitioning. The primary application of this algorithm is in controlpath design for instruction set processors. However it can easily be extended to combinatorial PLA's. Results for a number of machines from the MCNC benchmark set are shown. ESA

N92-14620# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
BUNDLE EVENT STRUCTURES: A NON-INTERLEAVING SEMANTICS FOR LOTOS
Rom Langerak 16 Jul. 1991 25 p Sponsored in part by Commission of the European Communities
(Memo-INF-91-60; TIOS-91/024; ISSN-0923-1714; ETN-92-90518) Avail: NTIS HC/MF A03

Bundle event structures are introduced as labeled event structures with a binary conflict relation and a so called bundle set instead of a causality, precedence or flow relation. Unlike in Winskel's prime event structures, an event in a bundle event structure can be enabled in different ways. This is a characteristic shared with Winskel's stable event structures and the flow event structures of Boudol and Castellani. However, flow event structures depend in general on the presence of self conflicting events. For bundle event structures, it is shown that it is always possible to remove all self conflicting events. A bundle event structure semantics is given for a Basic Language of Temporal Ordering Specification (LOTOS) subset. ESA

N92-14621# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
WEAK EQUIVALENCE FOR CONSTRAINT SETS
Sieger vanDenneheuvel and Karen L. Kwast Apr. 1991 10 p Presented at the 12th International Joint Conference on Artificial Intelligence, 1991 Submitted for publication
(ITLI-CT-91-05; ISSN-0924-8374; ETN-92-90520) Avail: NTIS HC/MF A02

A generalization of equivalence between constraint sets, called weak equivalence, is described. This new equivalence relation takes into account that not all variables have the same function in a constraint set and therefore distinguishes between restriction variables and intermediate variables. The properties of weak equivalence and its underlying notion of weak implication with an axiomatic approach, are explored. In addition a complete set of axioms for weak implication is presented. With examples derived from the declarative rule language RL, the applicability of weak equivalence to constraint solving is derived. ESA

N92-14622# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
LEVATIONIS LAUS
Kees Doets Jun. 1991 26 p
(ITLI-CT-91-08; ISSN-0924-8374; ETN-92-90523) Avail: NTIS HC/MF A03

In terms of the lifting phenomenon, a variant independent expression directed approach to linear resolution, which eliminates problems involving substitutions in existing expositions and culminates in a strengthened form of lifting, is presented. Additionally, a variation on lifting ground derivations is shown. Also discussed are fast proofs for standard theorems, results on infinite derivations, and greatest fixed points and the criteria for when these are reached after omega steps in the downward fixed point hierarchy. ESA

N92-14623# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
A RANDOMIZED ALGORITHM FOR TWO-PROCESS WAIT-FREE TEST-AND-SET
John Tromp and Paul M. B. Vitanyi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) Jun. 1991 21 p
(ITLI-CT-91-10; ISSN-0924-8374; ETN-92-90525) Avail: NTIS HC/MF A03

It is known to be impossible to implement wait free test and set deterministically in a concurrent setting using only atomic shared variables. It can be shown that n-process wait free test and set can be deterministically implemented from 2 process wait free test and set. A simple direct randomized algorithm for 2 process wait free test and set, implemented with two 4 valued single writer single reader atomic variables, is presented. The worst case (over all adversary schedulers) expected number of steps to execute a test and set between two processes is at most 11, while the reset takes exactly 1 step. Based on a finite state analysis, the proofs of correctness and expected length are compressed into one table. ESA

N92-14624# Royal Signals and Radar Establishment, Malvern (England).
TDF: SPECIFICATION OF SUBSET TO SUPPORT ANSI C, C++, FORTRAN 77, COBOL AND PASCAL
J. M. Foster, M. Brandreth, P. W. Core, I. F. Currie, and N. E. Peeling May 1991 102 p
(RSRE-91014; BR303121; ETN-92-90690) Copyright Avail: NTIS HC/MF A06

TDF is an intermediate format for distributing software applications. An overview of the TDF concept is given and the scene for the definition is set. The definition specifies each of the constructs which make up the subset of TDF. TDF can be produced from a wide range of programming languages and installed on a wide range of architectures. The languages which TDF1 was designed to cater for include ANSI C, C++, FORTRAN 77, COBOL, Pascal, Ada, MODULA 2, COMMON LISP and Standard ML. This document describes a subset of TDF for which prototype software exists which demonstrates its suitability for ANSI C. The subset described was also designed to support C++, FORTRAN 77, COBOL and Pascal. TDF is defined in the form of a data structure which is an abstract syntax for programs. It contains sufficient information to allow efficient machine code to be generated from it for a wide variety of computer architectures. A TDF data structure representing program is encoded into a linear stream of bits and resides in a file. The encoding of this stream of bits is both space efficient and extensible so as to allow upwards compatibility for any future enhancements or amendments to the TDF definition. ESA

N92-14625# Royal Signals and Radar Establishment, Malvern (England).
TRACEABILITY AND CONFORMANCE IN SECURE SYSTEMS
G. P. Randell and C. T. Sennett 7 Aug. 1991 31 p
(RSRE-91016; BR304210; ETN-92-90692) Copyright Avail: NTIS HC/MF A03

The problems of maintaining traceability, when developing large secure systems, and the ways in which technology may be used to support it are discussed. Traceability in a software intensive system is the ability to link statements of requirement with the implementation objects which satisfy them and the means used to demonstrate conformance. The purpose of the report is to discuss how traceability and conformance apply to practical software development. The nature of the security requirements, and the fundamentals for the conformance testing are discussed. The analysis shows traceability of current secure systems is inadaquate and recommendations for providing traceability within current technology are given. ESA

N92-14626# Royal Signals and Radar Establishment, Malvern (England).
SECURE REFINEMENT
Paul Smith (Secure Information Systems Ltd., Fleet, England) 12 Feb. 1991 20 p
(Contract SLS42c/719)
(RSRE-91019; BR303626; ETN-92-90693) Copyright Avail: NTIS HC/MF A03

The behavioral equivalence is identified as a mathematical notion of secure refinement for SMITE based systems and suitable proof obligation are proposed. The confidentiality of information in multilevel secure systems is maintained by sanitizing requests for information according to the requester's clearance. However, information can flow indirectly through subtle modulations of shared resources: so called signalling channels. These channels can be avoided in specifying secure systems, but as a system specification is progressively refined in the design process, extraneous behaviors can easily be introduced, opening up more and more signalling channels. The process of constructing a system which is free from signalling channels is of considerable importance. The requisite mathematical notions are reviewed. A discussion of secure refinement motivates the choice of behavioral equivalence as a useful definition. The definition is investigated in terms of model oriented Z specifications, and a proof obligation for behavioral equivalence is posited; behavioral equivalence is difficult to characterize for nondeterministic systems and the limitations are sketched. Behavioral equivalence is formally defined as a means to proving the validity of the proof obligation. ESA

N92-14627# Royal Signals and Radar Establishment, Malvern (England).
AN EXAMPLE MACHINE USED FOR DEVELOPING A PROOF STRATEGY FOR SECURE SYSTEMS
P. F. Terry (Capella Research Ltd., Camberley, England) Apr. 1991 79 p
(Contract SLS42c/720)
(RSRE-91022; BR304043; ETN-92-90694) Copyright Avail: NTIS HC/MF A05

A machine which is an abstraction of the archetypal Common, Control, Communications and Information (C-3I) system is described. The system was developed to meet procurement requests, operational requirements, invitations to tender, etc. from government and military agencies. The purpose of this report is to set the scope of complexity of structure, functionality, and policy which we believe the SMITE approach to secure-systems development can encompass. The following topics are included: the persistent/passive/storage structure, the transient/active/process structure, and the user activation/deactivation. It provides background and motivation for future research and encourages those involved in secure systems procurement to investigate further the SMITE approach. The Abstract Machine is first described in English with pictures and subsequently in the Z specification language. ESA

N92-14628# Royal Signals and Radar Establishment, Malvern (England).
PRACTICAL COMPUTATIONAL COMPLEXITY
D. E. Symonds Apr. 1991 15 p
(RSRE-Memo-4468; BR303455; ETN-92-90695) Copyright Avail: NTIS HC/MF A03

Computational Complexity Analysis is a very powerful tool for

use in designing algorithms. Unfortunately, the analysis can sometimes be misleading for the range of input with which the algorithm will actually be used. The aim is to first give an overview of what computational complexity is and how to analyze it, and then explain what parts of complexity analysis can cause confusion and how to avoid these mistakes. Ways of solving problems faster by sacrificing certain operating requirements are investigated. ESA

N92-14629# Royal Signals and Radar Establishment, Malvern (England).
A BI-DIRECTIONAL BAUDOT/ASCII CODE CONVERTER
L. Anderson May 1991 52 p Original contains color illustrations
(RSRE-Memo-4479; BR303454; ETN-92-90696) Copyright
Avail: NTIS HC/MF A04

The hardware and software, and the operating instructions, concerning a bidirectional code converter are presented. A unit was developed to interface between a terminal generating BAUDOT code at 75 Baud and terminal generating ASCII code at 9600 baud facilitating bidirectional serial communication. Due to the immediacy of the requirement, and the need for a flexible and low cost solution, an industry standard 8-bit microcontroller was chosen to perform all data processing and interface control between the applique unit and the two terminals. This flexibility in design resulted from the microcontroller's internal software control of all data handling functions and external interfacing protocols. This equipment can be easily reconfigured to operate at any baud rate by minor software alterations without the need for any hardware redesign. ESA

N92-14630# Royal Signals and Radar Establishment, Malvern (England).
NOTES ON THE POLYINSTANTIATION PROBLEM
Simon Wiseman Jul. 1991 15 p
(RSRE-Memo-4504; BR304234; ETN-92-90699) Copyright
Avail: NTIS HC/MF A03

The working notes concerning the database security technique called polyinstantiation are discussed. The first is the position paper that outlines the relationship between confidentiality and integrity in general terms. The second gives the more specific position relating to the problems of polyinstantiation and how they are avoided with the insert low approach. The third note gives an example which illustrates the difference in attitude towards integrity between polyinstantiation and the insert low approaches. There is a serious difference in the attitude to integrity constraints between the polyinstantiation and insert low approaches to database security. Polyinstantiation would rather that an integrity constraint was not enforced properly than activity was prevented. Insert low on the other hand would rather that activity is prevented than a constraint is violated. The potential problem with the insert low approach, denial of service, can be fixed by apopropriate data design, however with polyinstantiation the onus for integrity enforcement falls on the design and construction of the entire application software. The latter is not a sound economic proposition. ESA

N92-14631# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept. and ESA Fracture Control Board.
SOFTWARE PRODUCT ASSURANCE REQUIREMENTS FOR ESA SPACE SYSTEMS
Apr. 1991 38 p
(ESA-PSS-01-21-Issue-2; ISSN-0379-4059; ETN-92-90320)
Copyright Avail: NTIS HC/MF A03

The product assurance requirements for the software developed for ESA space systems where other level 2 Procedures Specifications and Standards (PSS) 01 specifications are applicable are presented. It supports the ESA Software Engineering Standard PSS-05-0 and explains the functions of product assurance, its management and the activities performed by product assurance for each phase of the software lifecycle. ESA

N92-14632# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
INCREASING THE EFFICIENCY OF AN ALGORITHM FOR SOLVING THE PROBLEM M(Y,G)
P. vanSchaik and S. M. Baas Dec. 1990 16 p
(MEMO-922; ISSN-0169-2690; ETN-92-90328) Avail: NTIS HC/MF A03

Possibilities for increasing the efficiency of an algorithm, which compares a family of strings obtainable from a regular grammar, are described. This algorithm includes a shortest path method, which is applied to a network. Possibilities for making the validation of arcs in the network less time consuming by calculating the length of only a restricted number of arcs and deriving a lower bound on the length of other arcs are investigated. Increasing the number of fixed arc lengths (at the cost of little calculation time) and obtaining a sharper lower bound for the remaining arcs are two possible refinements to this approach. ESA

N92-14633# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
JOINING DISTRIBUTED COMPLEX OBJECTS: DEFINITION AND PERFORMANCE
Wouter B. Teeuw and Henk M. Blanken May 1991 44 p Sponsored in part by the Netherlands Foundation for Computer Science
(Memo-INF-91-35; ISSN-0923-1714; ETN-92-90352) Avail: NTIS HC/MF A03

The performance of a non-standard distributed data base system is strongly influenced by complex objects. The effective exploitation of parallelism in querying them and a suitable structure to store them are required in order to obtain acceptable response times in these database environments where performance tends to be critical. An hierarchical complex object model with object references is used and several join operations for these complex objects, called tuple objects, are defined. These join queries for tuple objects can be categorized into materialized, functional and value based joins. An analytical performance evaluation gives insight into which distributed storage structures for tuple objects are most effective with regard to executing the different kinds of tuple object joins. ESA

N92-14634# Universiteit Twente, Enschede (Netherlands). Knowledge-Based Systems Group.
FOCUSING BASED ON THE STRUCTURE OF A MODEL-BASED DIAGNOSIS
P. Nooteboom and G. B. Leemeijer May 1991 32 p Sponsored by Stichting Knowledge Based Systems
(Memo-INF-91-41; UT-KBS-91-22; SKBS-A1/91-18;
ISSN-0923-1714; ETN-92-90357) Avail: NTIS HC/MF A03

The high computational complexity of existing methods for model based diagnosis imposes a limit on the application of those methods in practical situations. Therefore, a lot of research is spent on methods that improve the tractability of model based diagnosis. A new method for improving the tractability of model based diagnosis is presented. The reasoning mechanism used is restricted to a subset of the components in the model called the focus. This focus is selected during diagnosis, based on the structure of the model and the observed values at the system outputs, and measurable connections in the model. Experiments have shown that focusing improves the practical applicability of model based diagnosis. A method for ordering the resulting set of diagnoses in a way analogous to determining a focus that is based on the structure of the model and observations available is discussed. ESA

N92-14635# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
EVENT STRUCTURES FOR DESIGN AND TRANSFORMATION IN LOTOS
Rom Langerak 31 May 1991 19 p Sponsored in part by Commission of the European Communities
(Memo-INF-91-45; TIOS-91/014; ISSN-0923-1714; ETN-92-90360)
Avail: NTIS HC/MF A03

An event structure semantics for LOTOS is introduced in an intuitive and graphical way. The usefulness of event structures for design and transformation is sketched in several examples: decomposition of functionality, design of a FIFO buffer, and action refinement. In the appendix, a comparison is made between several different event structure models. ESA

N92-14636# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
AN EXERCISE IN PROTOCOL SYNTHESIS
Peter vanEijk and Jeroen Schot 31 May 1991 18 p
(Memo-INF-91-46; TIOS-91/015; ISSN-0923-1714; ETN-92-90361) Avail: NTIS HC/MF A03

Earlier claims that a protocol should be designed on the basis of a service definition are addressed. An example in which this is done entirely in LOTOS and entirely with correctness preserving transformations is worked through. Thus, it is an example of applying formal methods in a design process, and not just in a design representation. The techniques introduced are believed to constitute a novel contribution to the craft of protocol design. ESA

N92-14637# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
SYMBOLIC EXECUTION OF LOTOS SPECIFICATIONS
Henk Eertink and Dietmar Wolz (Technische Univ., Berlin, Germany, F.R.) May 1991 22 p Sponsored by Commission of European Communities
(Memo-INF-91-47; TIOS-91/016; ISSN-0923-1714; ETN-92-90362) Avail: NTIS HC/MF A03

The design and implementation of SMILE, a full LOTOS symbolic execution tool, is discussed. Besides expansion functionalities for LOTOS behavior expressions, the tool also includes an implementation of a narrowing algorithm. Usage of the tool in the implementation of speficiations is demonstrated and a new approach to specification validation by means of testing is proposed. ESA

N92-14638# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
ADDRESSING PERFORMANCE REQUIREMENTS IN THE FDT BASED DESIGN OF DISTRIBUTED SYSTEMS
Jeroen Schot Jun. 1991 22 p Submitted for publication Sponsored in part by Commission of the European Communities
(Memo-INF-91-48; TIOS-91/018; ISSN-0923-1714; ETN-92-90363) Avail: NTIS HC/MF A03

The development of distributed systems is generally regarded as a complex and costly task, and for this reason Formal Description Techniques (FDT's) such as LOTOS and ESTELLE are increasingly used in this process. It was experienced that LOTOS can be exploited at many stages on the design trajectory from requirements specification of implementation; however, the language elements do not allow direct formalization of performance requirements. In order to avoid duplication of effort by using two formalisms with distinct approaches, a design method that incoporates performance constraints in a heuristic but effective manner is proposed. ESA

N92-14639# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
COMPOSITE PERFORMANCE AND DEPENDABILITY ANALYSIS
Kishor S. Trivedi, Jogesh K. Muppala, Steven P. Woolet (International Business Machines Corp., Research Triangle Park, NC.), and Boudewijn R. Haverkort 7 Jun. 1991 33 p Submitted for publication
(Memo-INF-91-50; TIOS-91/019; ISSN-0923-1714; ETN-92-90365) Avail: NTIS HC/MF A03

Composite performance and dependability analysis is gaining importance in the design of complex, fault tolerant systems. Markov reward models are most commonly used for this pupose. An introduction to Markov reward models including solution techniques and application examples is presented. Extensions of Markov reward models to semi-Markov reward models are mentioned. A discussion of how task completion time models and models of queues with breakdowns and repairs relate to Markov reward models is given. ESA

N92-14640# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
GEOGRAPHIC DATA MODELLING IN TM
Bert R. M. vandenAkker and Henk M. Blanken 13 Jun. 1991 18 p
(Memo-INF-91-53; ISSN-0923-1714; ETN-92-90368) Avail: NTIS HC/MF A03

Current object oriented systems contain integration of data and methods that are formulated in third generation programming languages. Additionally, inheritance of data and methods is typically based on operational semantics. However, the object oriented data modelconceived by Twente university and Milan polytechnic (TM) contains rich data structuring capabilities, a high level specification of methods and constraints, and inheritance for data, methods, and constraints. Moreover TM has formal semantics. It is shown that TM can be used to specify complex application environments. In environments with confusion concepts, TM is of great help in giving brief and unambiguous specifications. A geographic data base application is used as an example. It is shown that the TM extensions to current object oriented data models are welcome new modeling tools. ESA

N92-14641# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
CONSTRUCTIVE FIXPOINT SEMANTICS FOR TRUTH MAINTENANCE SYSTEMS
Cees Witteveen 1990 37 p
(Rept-90-85; ISSN-0922-5641; ETN-92-90373) Copyright Avail: NTIS HC/MF A03

Recently, advances have been made in the semantics of Truth Maintenance Systems (TMS) by proving the equivalence of its grounded model semantics and the stable model semantics for logic programming. This result, however, can only be used to characterize grounded models, but not to construct them. A logical reconstruction of some approaches to 'construct' a grounded model for truth maintenance is offered. This leads to a constructive fixed point characterization of grounded models. For a large subclass of TMS, this semantics is equivalent to the already developed theoretically grounded model semantics. Compared with previous approaches, the new approach offers the possibility to base the proof of correctness of the algorithm on model theoretical and fixpoint approaches in logic programming; moreover, by using these techniques, it permits the development of a faster algorithm (O(n squared)) than hitherto was known. ESA

N92-14642# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
CONSTRUCTIVE IDENTIFICATION WITH POOLE'S DEFAULT LOGIC
Willem Evert Nijenhuis (Physics and Electronics Lab. TNO, The Hague, Netherlands) and Cees Witteveen 1990 36 p
(Rept-90-86; ISSN-0922-5641; ETN-92-90374) Copyright Avail: NTIS HC/MF A03

Intelligent reasoning requires dealing with incomplete knowledge. Default logics are a powerful tool for modeling these non monotonic reasoning processes. In these logics no attention is paid to the question of how to build a representation of a certain discourse. An inductive mechanism for determining default rules from specific examples (a learning system) is investigated. The study proceeds from an existing inductive identification method for simple representations. To use this method with a logic requires the logic to have certain properties. Poole's default logic concerning these properties is investigated and its use for inductive identification is shown. ESA

N92-14643# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
A FAST PARALLEL EARLEY BOTTOM UP RECOGNIZER

J. P. M. deVreught 1990 21 p
(Rept-90-88; ISSN-0922-5641; ETN-92-90376) Copyright Avail: NTIS HC/MF A03

There exist several algorithms that can recognize a language in L2 described by a CFG (Context Free Grammar). The Earley algorithm is such an algorithm. For this algorithm a slow parallel version exists that runs in a bottom up fashion. A fast parallel version of that algorithm is described, which runs in O(log n) time with Theta(n to the 6th power) processors on a CRCW-PRAM. Furthermore, a fast parallel parser for acyclic grammars is described, which runs in O(log n) time using Theta(n to the 6th power) processors on a CREW-PRAM. ESA

N92-14644# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
DIALOGUE STRUCTURING
J. vanderLeeuw, A. M. C. vanRijn, and R. Sommerhalder 1990 49 p
(Rept-90-89; ISSN-0922-5641; ETN-92-90377) Copyright Avail: NTIS HC/MF A03

After discussion of a number of existing theories and formalisms for dialogue structure regulation, a formalism is proposed. A solution to the structuring problem seems the division of the aspects of an utterance in the aspect of the inherent meaning of utterances and the aspect of the structural function of utterances. The inherent meaning of an utterance is described with a logical language and the structural function of an utterance is described with a sequent transition system. The formalism follows speech act theory in making this distinction, for in speech act theory a similar distinction is made. The formalism is theoretically well founded and can be enhanced to result in a formalism which describes a large part of human dialogue in an adequate way. The most important aspect of the developed formalism is the fact that by developing it the possible use of such simple formalisms for solving such highly complex language problems was researched. ESA

N92-14645# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
A CSG SCANLINE ALGORITHM FOR QUADRICS
Reinier vanKleij and Ronald Roussou 1990 21 p
(Rept-90-90; ISSN-0922-5641; ETN-92-90378) Copyright Avail: NTIS HC/MF A03

CSG (Constructive Solid Geometry) is a method for defining complex solid objects as a combination of simple primitives. An efficient scanline display algorithm for CSG models with quadric primitives is presented. Efficiency is gained by making use of silhouette curves, and by splitting the scanline sections into monotonic pieces, which allows efficient testing for interactions on spans and avoids the calculation of depth values of the faces at every pixel. A procedure for the selective skipping of spans, which in complex cases leads to a substantial reduction of the number of spans to be processed and gives an increase of the average length of the spans, is given. ESA

N92-14646# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ALGORITHMS FOR THE CORRECT IMPLEMENTATION OF SCHEDULING POLICIES IN DISTRIBUTED SYSTEMS
D. H. J. Epema 1990 25 p
(Rept-90-91; ISSN-0922-5641; ETN-92-90379) Copyright Avail: NTIS HC/MF A03

One of the main objectives of distributed systems is improvement of performance. An important way to achieve this is to move waiting jobs from busy to idle processors, or more generally, from heavily loaded to lightly loaded processors. A variety of distributed scheduling policies, amongst which generalizations of centralized policies (for example global First Come First Served (FCFS) and truly distributed policies such as Join Shortest Queue (JSQ)), are proposed and analyzed from a queuing theoretic perspective. Relatively little attention is paid to distributed algorithms implementing these policies correctly. An algorithm for global FCFS is presented; its correctness is proven, and its message complexity is obtained. The basic mechanisms needed to implement FCFS are shown to suffice, with minor changes, for a range of other sender initiated policies, such as JSQ, as well. ESA

N92-14647# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
A COMPARISON OF SOME QUICK ALGORITHMS FOR ROBUST REGRESSION
Peter J. Rousseeuw and Bert C. vanZomeren 1990 19 p
(Rept-90-92; ISSN-0922-5641; ETN-92-90380) Copyright Avail: NTIS HC/MF A03

Existing breakdown regression estimators need substantial computation time. Two less time consuming alternatives with a breakdown point of 1/3 are proposed. This is not the highest value possible, but it is independent of the number of predictor variables. Both algorithms start by identifying unusual points by computationally cheap robust estimates of location and scale of x space or (x,y) space, and then apply L sub 1 regression to the remaining points. Two somewhat more refined variants of these methods are discussed, both based on resampling, but using only a very limited number of subsamples. Some examples are given, and a small simulation study is presented. It appears that in these cases the new algorithms perform equally well as more time consuming estimators. ESA

N92-14648# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
CASE STUDY OF A NATIONAL EDUCATIONAL SOFTWARE DEVELOPMENT PROGRAM: THE NETHERLANDS
Charles vanderMast, Frans Hartemink, and Leon Henkens (Ministry of Education and Sciences-Documentation Dept., The Hague, Netherlands) 1991 23 p Submitted for publication
(Rept-91-15; ISSN-0922-5641; ETN-92-90395) Copyright Avail: NTIS HC/MF A03

A survey of the results of a four year national program for courseware development is presented. The strategy of the program within the Dutch educational system is described as well as the characteristics of the infrastructure used to create courseware on a professional way and scale. The methodologies and techniques that were used are described along with the discussion of the outcomes in selected projects. Those involved were satisfied with the project management approach that was taken with respect to the quality of the resulting software, the time table within which it was produced as well as the budgeting process that was employed. However, problems remain with respect to the implementation of the courseware into the schools and the creation of semi-commercial markets. ESA

N92-14649*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MisTec: A SOFTWARE APPLICATION FOR SUPPORTING SPACE EXPLORATION SCENARIO OPTIONS AND TECHNOLOGY DEVELOPMENT ANALYSIS AND PLANNING
Gary A. P. Horsham Nov. 1991 15 p Proposed for presentation at the Space Programs and Technologies Conference, Huntsville, AL, 24-27 Mar. 1992; sponsored by AIAA
(NASA-TM-105214; E-6529; NAS 1.15:105214; AIAA-92-1293) Avail: NTIS HC/MF A03 CSCL 09B

The structure and composition of a new, emerging software application, which models and analyzes space exploration scenario options for feasibility based on technology development projections is presented. The software application consists of four main components: a scenario generator for designing and inputting scenario options and constraints; a processor which performs algorithmic coupling and options analyses of mission activity requirements and technology capabilities; a results display which graphically and textually shows coupling and options analysis results; and a data/knowledge base which contains information on a variety of mission activities and (power and propulsion) technology system capabilities. The general long-range study process used by NASA to support recent studies is briefly introduced to provide the primary basis for comparison for discussing the potential advantages to be gained from developing

and applying this king of application. A hypothetical example of a scenario option to facilitate the best conceptual understanding of what the application is, how it works, or the operating methodology, and when it might be applied is presented. Author

N92-14650# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
EFFICIENT HYBRID RENDERING OF VOLUME DATA AND POLYGONS
Theo vanWalsum, Andreas J. S. Hin, Jack Versloot, and Frits H. Post 1991 22 p Original contains color illustrations
(Rept-91-17; ISSN-0922-5641; ETN-92-90397) Copyright Avail: NTIS HC/MF A03

Techniques for efficient visualization of any combination of volume data (scalar field) and polygon data are presented. The scalar field is rendered using ray casting, and polygons using a depth buffer algorithm. Ray casting efficiency is improved using an item buffer produced during polygon scan conversion. The efficiency of ray casting is further improved by adaptive sampling in the screen plane, using an object space refinement criterion. For sampling the scalar field in depth along the ray, four different strategies are compared in performance and image quality. ESA

N92-14651# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
A FULLY ABSTRACT MODEL FOR CONCURRENT CONSTRAINT PROGRAMMING
Frank S. deBoer and Catuscia Palamidessi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) May 1991 25 p
(RUU-CS-91-10; ISSN-0924-3275; ETN-92-90474) Avail: NTIS HC/MF A03

Recent results have shown that concurrent logic programming has a very simple model, based on linear sequences, which is fully abstract with respect to the parallel operator and finite observables. This is intrinsically related to the asynchronous and monotonic nature of the communication mechanism, which consists of asking and telling constraints on a common store. A paradigm for (asynchronous) concurrent programming, based on the above mechanism and provided with the standard operators of choice, parallelism, prefixing, and hiding of local variables, is considered. It comes out that linear sequences still suffice for a compositional description of all the operators. The problem of full abstraction is considered. Since the notion of observables implies the removal of silent steps, the presence of the choice operator induces the same problems (for compositionality) as bisimulation in CCS. It is shown that in the present framework this problem has a simple solution which consists of introducing a semantical distinction between the various ways in which deadlock and failure might occur. The resulting semantics are fully abstract and are still based on linear sequences. ESA

N92-14652*# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
PRELIMINARY BASIC PERFORMANCE ANALYSIS OF THE CEDAR MULTIPROCESSOR MEMORY SYSTEM
K. Gallivan, W. Jalby, S. Turner, A. Veidenbaum (Illinois Univ., Urbana.), and H. Wijshoff Jun. 1991 28 p Sponsored in part by Cray Research Inst., and Alliant Computer Systems
(Contracts NCC2-559; DE-FG02-85ER-25001; NSF 89-20891)
(NASA-CR-189542; NAS 1.26:189542; RUU-CS-91-15; ISSN-0924-3275; ETN-92-90479) Avail: NTIS HC/MF A03 CSCL 09B

Some preliminary basic results on the performance of the Cedar multiprocessor memory system are presented. Empirical results are presented and used to calibrate a memory system simulator which is then used to discuss the scalability of the system. ESA

N92-14653# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TERMINATION OF TERM REWRITING: FROM MANY-SORTED TO ONE-SORTED
H. Zantema Jun. 1991 16 p
(RUU-CS-91-18; ISSN-0924-3275; ETN-92-90482) Avail: NTIS HC/MF A03

A property of many sorted term rewriting systems is called persistent if it is not affected by removing the corresponding typing restriction. Persistency turns out to be a generalization of direct sum modularity. Strong normalization is shown to be persistent for the class of term rewriting systems for which both duplicating rules and collapsing rules do not occur, generalizing a similar result of Rusinowitch for modularity. ESA

N92-14654# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
EMBEDDING AS A TOOL FOR LANGUAGE COMPARISON: ON THE CSP HIERARCHY
Frank S. deBoer and Catuscia Palamidessi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) Jul. 1991 20 p
(RUU-CS-91-24; ISSN-0924-3275; ETN-92-90488) Avail: NTIS HC/MF A03

The concept of embedding was recently introduced as a formal tool to study the relative expressive power of (concurrent) programming languages. The motion of 'modular embedding' is used to compare various dialects of Communicating Sequential Processes (CSP) and Asynchronous CSP (ACSP), which differ on the kind of communication primitives allowed in the guards: all, only input, or none. Concerning the synchronous paradigm, CSP is strictly more powerful than CSP(I) (the version of CSP with no communication primitives in the guards). The first separation result does not hold in the asynchronous variants of these languages; since asynchronous output guards cannot be influenced by the environment (they can always proceed), it is irrelevant to have or not to have them in the language. Therefore, ACSP and ACSP(I) are equivalent. Still, they are strictly more expressive than ACSP(0). The synchronous and asynchronous paradigms are compared. The asynchronous communication can be modeled synchronously by means of buffer processes. On the other hand, synchronous communication (when not fully used to control nondeterminism) can be modeled asynchronously by means of acknowlegement messages. As a consequence, CSP(I), ACSP, and ACSP(I) are equivalent. An interesting corollary of these results is that ACSP is strictly less powerful than CSP. ESA

N92-14655# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Technical Support Dept.
TRIANGLE SETS IN PHIGS PLUS: A VALUABLE LINK WITH FINITE ELEMENT MODELING
Miente Bakker Feb. 1991 11 p Submitted for publication
(CWI-CS-R9110; ETN-92-90550) Copyright Avail: NTIS HC/MF A03

The addition of an output to PHIGS (Programmer's Hierarchical Interactive Graphics System) PLUS: TRIANGLE SET 3 WITH DATA together with its two dimensional shorthand is addressed. The principal reason for the addition was that only triangular primitives admit uniquely defined interpolation of data (colors, normals, etc.) across the facet. However, an additional advantage of this new primitive is its value for the visualization of scientific computing results. It corresponds in a very pleasant way with the Finite Element Method (FEM) using piecewise linear blending functions on a triangular partition of the functional domain. An outline of the possible use of this function by FE engineers is given. ESA

N92-14092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
QUATERNION NORMALIZATION IN ADDITIVE EKF FOR SPACECRAFT ATTITUDE DETERMINATION
I. Y. Bar-Itzhack (Technion - Israel Inst. of Tech., Haifa.), J. Deutschmann, and F. L. Markley *In its* Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 403-421 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 09B

N92-14240*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
A COMPARISON OF THE FRACTAL AND JPEG ALGORITHMS
K.-M. Cheung and M. Shahshahani *In its* The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 21-26 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

N92-14242*# Johns Hopkins Univ., Baltimore, MD.
DETERMINATE-STATE CONVOLUTIONAL CODES
O. Collins and M. Hizlan *In* JPL, The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 36-56 Sponsored in part by NSF (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

N92-14243*# California Univ., Davis.
SOME PARTIAL-UNIT-MEMORY CONVOLUTIONAL CODES
K. Abdel-Ghaffar, R. J. McEliece, and G. Solomon (California Inst. of Tech., Pasadena.) *In* JPL, The Telecommunications and Data Acquisition Report 15 Nov. 1991 p 57-72 (For primary document see N92-14237 05-32)
Avail: NTIS HC/MF A08 CSCL 09B

N92-14774*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADVANCED COMPUTING
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 57-79 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 09B

N92-14905*# Arizona Univ., Tucson.
COMPARISON OF DIFFERENT FRACTAL DIMENSION MEASURING ALGORITHMS FOR RE-TM M-O FILMS
Bruce E. Bernacki and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 85-93 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-14656*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
INTEGRATING SECURITY IN A GROUP ORIENTED DISTRIBUTED SYSTEM
Michael Reiter, Kenneth Birman, and Li Gong (ORA Corp., Cambridge, MA.) Oct. 1991 27 p Sponsored in part by GTE Sylvania, Inc.; IBM; Siemens, Inc.; and NSF
(Grant NAG2-593)
(NASA-CR-189498; NAS 1.26:189498; TR-91-1239) Avail: NTIS HC/MF A03 CSCL 09B

A distributed security architecture is proposed for incorporation into group oriented distributed systems, and, in particular, into the Isis distributed programming toolkit. The primary goal of the architecture is to preserve the Isis abstractions in hostile environments. These abstractions include process groups and causal and atomic group multicast. Moreover, a delegation and access control scheme is proposed for use in group oriented systems. The focus here is on the security architecture; particular security protocols and cryptosystems are not emphasized.
Author

N92-14657# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 1, PART 1, TASK 1: DIGITAL EMULATION TECHNOLOGY LABORATORY Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Thomas R. Collins, and Stephen R. Wachtel 27 Sep. 1991 151 p
(Contract DASG60-89-C-0142)
(AD-A241691) Avail: NTIS HC/MF A08 CSCL 12/5

The Digital Emulation Technology Laboratory (DETL) is a principal unit within the Computer Engineering Research Laboratory (CERL) at Georgia Tech. This report addresses the objectives, requirements, and schedule of the DETL relative to contract number DASG60-89-C-0142. This contract concerns activity associated with the effort to develop an integrated hardware and software environment for end-to-end emulations of exoatmospheric interceptors such as EXOSIM. This includes the Georgia Tech Parallel Function Processor (PFP), system software for the PFP (utilities and parallel programming tools), and application software (EXOSIM). Some discussion of interfaces to specialized external hardware like the Seeker Scene Emulator (SSE) will also be included. Within DETL, there are two main hardware systems: the PFP and the SSE. Each of these systems is a complex parallel processor, designed to function together as an emulation facility for kinetic energy weapons systems. Software development is also an active area of research, both at the system level (compilers, loaders, graphics development) and at the application level (simulation and emulation studies). GRA

N92-14658# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 1, PART 2, TASK 1: DIGITAL EMULATION TECHNOLOGY LABORATORY Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Thomas R. Collins, and Stephen R. Wachtel 27 Sep. 1991 542 p
(Contract DASG60-89-C-0142)
(AD-A241692) Avail: NTIS HC/MF A23 CSCL 12/5

Part 2 is comprised of Appendices D - M (inclusive). The information contained is the individual appendices is as follows: Appendix D, common program source; Appendix E, ctimer program source; Appendix F, declare program source; Appendix G, equivalence program source; Appendix H, etimer program source; Appendix I, initial program source; Appendix J, namelist program source; Appendix K, network program source; Appendix L, structure program source; and Appendix M, usage program source. GRA

N92-14659# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 1, PART 3, TASK 1: DIGITAL EMULATION TECHNOLOGY LABORATORY Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Thomas R. Collins, and Stephen R. Wachtel 27 Sep. 1991 199 p
(Contract DASG60-89-C-0142)
(AD-A241693) Avail: NTIS HC/MF A09 CSCL 12/5

Part 3 is one of the appendices (appendix N) for Volume 1 and is the presentation of a lengthy applications program. The program is EXOSIM version 2.0 (End to end). GRA

N92-14660# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 2, TASK 2: SEEKER SCENE EMULATOR DEVELOPMENT Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Andrew Henshaws, Stephen Gieseking, and Roy Melton 27 Sep. 1991 226 p
(Contract DASG60-89-C-0142)
(AD-A241694) Avail: NTIS HC/MF A11 CSCL 12/5

The Seeker Scene Emulator (SSE) is an important element of the Digital Emulation Technology Laboratory (DETL). The SSE provides for real time emulation of advanced Infrared Focal Plane Arrays, and thus, for real time testing of closed loop missile simulations and real time testing of signal and object processing components. Several programs described in this volume are not strictly SSE derived (the Neural Network Signal Processing, for example), however, these projects are dependent upon the SSE for testing. For this reason, LATS interfacing and Neural Network Signal Processing are included in this volume. GRA

N92-14661# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 4, TASK 4: SOFTWARE DEVELOPMENT Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Wei S. Tan, R. Indaheng, J. Lie, and M. Alibakhsh 27 Sep. 1991 29 p
(Contract DASG60-89-C-0142)
(AD-A241695) Avail: NTIS HC/MF A03 CSCL 12/5

Software development at the Computer Engineering Research Laboratory is discussed. Among the areas being investigated currently are the following: software for the Parallel Function Processor (PFP); conversion of the PFP host to SparcStation; a sequencer grade; Ada development strategy; and the Integrated Parallel Programming Framework. GRA

N92-14662# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 5, TASK 5: GN/C PROCESSOR DEVELOPMENT AND PFP INTEGRATION Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Michael B. Woods, Richard M. Pitts, and Philip R. Bingham 27 Sep. 1991 125 p
(Contract DASG60-89-C-0142)
(AD-A241696) Avail: NTIS HC/MF A06 CSCL 17/7

The Guidance, Navigation, and Control (GN and C) processor is being built from custom designed VLSI chips. This volume covers the board level designs, system packaging, integration of a prototype into the Parallel Function Processor (PFP) environment for testing, and plans for using the PFP to test a radiation hardened version of the processor. The PFP is a 64 processor digital computer for use in computationally intensive applications that can be partitioned into functional blocks. The processors are grouped in two 32 processor clusters running from one common host. Each 32 processor cluster is connected by a crossbar switch. All interprocessor communication takes place over the crossbar(s). Simultaneous transfers may take place independently and switch patterns may be changed every cycle. In order to program the machine correctly, all inter-processor communication and data transfer lengths must be known beforehand. GRA

N92-14663# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 6, TASK 6: GN/C PROCESSOR TEST AND EVALUATION Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford and Wei S. Tan 27 Sep. 1991 99 p
(Contract DASG60-89-C-0142)
(AD-A241697) Avail: NTIS HC/MF A05 CSCL 09/1

Computer Engineering Research Laboratory (CERL) has developed a set of VLSI (Very Large Scale Integration) chip set for the Guidance, Navigation, and Control (GN and C) of the next generation interceptors for the Strategic Defense Initiative applications. The processor is called the GN and C processor and collectively the VLSI chip set is called the GN and C chip set. The GN and C processor consists of three functional types: executive processor, signal processor, data processor, and interconnection network. This document presents the test and evaluation methodology for the GN and C chip set, The GN and C processor board, and the development of a special test board. GRA

N92-14664# Georgia Tech Research Inst., Atlanta.
GUIDANCE, NAVIGATION AND CONTROL DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 7, TASK 7: VLSI DEVELOPMENT Annual Report, 28 Sep. 1990 - 27 Sep. 1991
Cecil O. Alford, Wei S. Tan, S. H. Russ, J. I. Chamdani, and A. Register 27 Sep. 1991 46 p
(Contract DASG60-89-C-0142)
(AD-A241698) Avail: NTIS HC/MF A03 CSCL 09/1

Under the Strategic Defense Command, Kinetic Energy Weapons (KEW) Directorate, Georgia Tech is developing a set of modular Very Large Scale Integration (VLSI) chips that can be used to construct a light weight, low power, and high performance flight computer to guide, navigate, and control (GN and C) advanced KEW interceptors. This effort involves an in depth study of GN and C algorithms, modularization of the algorithms, implementation of the algorithm in VLSI chips, testing, and evaluation of the chip sets as a system. The primary objective of the GN and C research effort is to develop the technology necessary to construct a lightweight, low power, high performance flight computer for guidance, navigation, and control of advanced KEW interceptors. The mission of the flight computer is to guide the interceptor to a point in space during the boost phase, receive update information and orient the interceptor to a designated target space during midcourse, track the targets and perform necessary maneuvers, and divert operations to guide the interceptor into an incoming RV (reentry vehicle) at the terminal phase. GRA

N92-14665# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
POLYNOMIAL-TIME TRANSFORMATIONS AND SCHEDULABILITY ANALYSIS OF PARALLEL REAL-TIME PROGRAMS WITH RESTRICTED RESOURCE CONTENTION
Alexander D. Stoyenko and Thomas J. Marlowe (Seton Hall Univ., South Orange, NJ.) 19 Jun. 1991 19 p
(Grant NATO-CRG-90/1077)
(Memo-INF-91-55; ISBN-90-365-0454-6; ISSN-0924-3755; ETN-92-90515) Avail: NTIS HC/MF A03

Polynomial time static semantics preserving transformations of real time programs are presented. Used in conjunction with schedulability analysis, the transformations significantly increase the class of real time programs that may be analyzed efficiently for guaranteed schedulability at compile time. In cases where the form of resource contention among processess resist efficient transformation, a heuristic transformation (and a consequent run time scheduling heuristic) to allow the programs to be analyzed efficiently is applied. ESA

N92-14666# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DYNAMIC ACTION SCHEDULING IN A PARALLEL DATABASE SYSTEM
Paul W. P. J. Grefen 9 Jul. 1991 33 p
(Memo-INF-91-58; ISSN-0924-3755; ETN-92-90517) Avail: NTIS HC/MF A03

Database machines are meant to obtain high performance in transaction processing, both in terms of response time and throughput. To obtain high performance, an accurate scheduling of the execution of the various actions in the transactions is crucial. A technique that schedules the execution of actions as clearly as possible without violating transaction semantics is described. The scheduling is based on dependencies between actions within one transaction and between actions belonging to multiple concurrent transactions. Transaction analysis and scheduling are performed completely at transaction execution time, taking dynamic aspects of the execution into account. The technique is first described using a conceptual graph based approach. This approach is applied in an abstract system architecture, showing how action scheduling can be integrated into a database management system. This integration was realized in the PRISMA parallel main memory database system. Measurements on this system demonstrate the effectiveness of the scheduling technique for reduction of transaction response times and improvement of system throughput. ESA

N92-14667# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
NETWORK ORIENTATION
Gerard Tel Mar. 1991 50 p
(Contract EEC-3075)
(RUU-CS-91-8; ISSN-0924-3275; ETN-92-90472) Avail: NTIS HC/MF A03

The influence of the symmetry of a processor network on the existence of a solution for the network orientation problem is

analyzed. The orientation of cliques, hypercubes, and tori is the problem of assigning labels to each link of each processor, in such a way that a sense of direction is given to the network. The problem of network orientation for these three topologies is studied under the assumptions that the network contains a single leader, that the processors possess unique identities, and that the network is anonymous. The distinction between these three models is considered fundamental in distributed computing. It is shown that orientations can be computed by deterministic algorithms only when either a leader or unique identities are available. Orientations can be computed for anonymous networks by randomized algorithms, but only when the number of processors is known. When the number of processors is not known, even randomized algorithms cannot compute orientations for anonymous processors networks. Lower bounds on the message complexity of orientation and algorithms achieving these bounds are given. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-14668*# Research Inst. for Advanced Computer Science, Moffett Field, CA.

TEMPORAL LEARNING IN THE CEREBELLUM: THE MICROCIRCUIT MODEL

Coe F. Miles (RECOM Technologies, Inc., Moffett Field, CA.) and David Rogers Sep. 1990 14 p

(Contracts NAS2-12952; NCC2-408; NCC2-387)

(NASA-CR-188873; NAS 1.26:188873; RIACS-TR-90-37) Avail: NTIS HC/MF A03 CSCL 09B

The cerebellum is that part of the brain which coordinates motor reflex behavior. To perform effectively, it must learn to generate specific motor commands at the proper times. We propose a fundamental circuit, called the MicroCircuit, which is the minimal ensemble of neurons both necessary and sufficient to learn timing. We describe how learning takes place in the MicroCircuit, which then explains the global behavior of the cerebellum as coordinated MicroCircuit behavior. Author

N92-14669*# Cincinnati Univ., OH. Dept. of Electrical and Computer Engineering.

A NEURAL NETWORK ARCHITECTURE FOR IMPLEMENTATION OF EXPERT SYSTEMS FOR REAL TIME MONITORING Final Report

P. A. Ramamoorthy 25 Sep. 1991 43 p

(Grant NAG3-960)

(NASA-CR-188988; NAS 1.26:188988) Avail: NTIS HC/MF A03 CSCL 09B

Since neural networks have the advantages of massive parallelism and simple architecture, they are good tools for implementing real time expert systems. In a rule based expert system, the antecedents of rules are in the conjunctive or disjunctive form. We constructed a multilayer feedforward type network in which neurons represent AND or OR operations of rules. Further, we developed a translator which can automatically map a given rule base into the network. Also, we proposed a new and powerful yet flexible architecture that combines the advantages of both fuzzy expert systems and neural networks. This architecture uses the fuzzy logic concepts to separate input data domains into several smaller and overlapped regions. Rule-based expert systems for time critical applications using neural networks, the automated implementation of rule-based expert systems with neural nets, and fuzzy expert systems vs. neural nets are covered. For individual titles, see N92-14670 through N92-14670.

N92-14670*# Cincinnati Univ., OH. Dept. of Electrical and Computer Engineering.

AUTOMATED IMPLEMENTATION OF RULE-BASED EXPERT SYSTEMS WITH NEURAL NETWORKS FOR TIME-CRITICAL APPLICATIONS

P. A. Ramamoorthy, Song Huang, and Girish Govind *In its* A Neural Network Architecture for Implementation of Expert Systems for Real Time Monitoring 25 Sep. 1991 33 p (For primary document see N92-14669 05-63)

Avail: NTIS HC/MF A03 CSCL 09B

In fault diagnosis, control and real-time monitoring, both timing and accuracy are critical for operators or machines to reach proper solutions or appropriate actions. Expert systems are becoming more popular in the manufacturing community for dealing with such problems. In recent years, neural networks have revived and their applications have spread to many areas of science and engineering. A method of using neural networks to implement rule-based expert systems for time-critical applications is discussed here. This method can convert a given rule-based system into a neural network with fixed weights and thresholds. The rules governing the translation are presented along with some examples. We also present the results of automated machine implementation of such networks from the given rule-base. This significantly simplifies the translation process to neural network expert systems from conventional rule-based systems. Results comparing the performance of the proposed approach based on neural networks vs. the classical approach are given. The possibility of very large scale integration (VLSI) realization of such neural network expert systems is also discussed. Author

N92-14671*# Martin Marietta Space Systems, Inc., Denver, CO. Astronautics Group.

INTELLIGENT ROBOTIC SYSTEMS STUDY (IRSS), PHASE 3 Final Report

Sep. 1991 36 p

(Contract NAS8-36431)

(NASA-CR-184261; NAS 1.26:184261; MCR-91-1340) Avail: NTIS HC/MF A03 CSCL 09B

This phase of the Intelligent Robotic Systems Study (IRSS) examines some basic dynamics and control issues for a space manipulator attached to its worksite through a compliant base. One example of this scenario is depicted, which is a simplified, planar representation of the Flight Telerobotic Servicer (FTS) Development Test Flight 2 (DTF-2) experiment. The system consists of 4 major components: (1) dual FTS arms to perform dextrous tasks; (2) the main body to house power and electronics; (3) an Attachment Stabilization and Positioning Subsystem (ASPS) to provide coarse positioning and stabilization of the arms, and (4) the Worksite Attachment Mechanism (WAM) which anchors the system to its worksite, such as a Space Station truss node or Shuttle bay platform. The analysis is limited to the DTF-2 scenario. The goal is to understand the basic interaction dynamics between the arm, the positioner and/or stabilizer, and the worksite. The dynamics and controls simulation model are described. Analysis and simulation results are presented. Author

N92-14672*# Martin Marietta Space Systems, Inc., Denver, CO. Astronautics Group.

INTELLIGENT ROBOTIC SYSTEMS STUDY (IRSS), PHASE 4 Final Report

Oct. 1991 52 p

(Contract NAS8-36431)

(NASA-CR-184262; NAS 1.26:184262; MCR-91-1341) Avail: NTIS HC/MF A04 CSCL 09B

Under the Intelligent Robotics Systems Study (IRSS), a generalized robotic control architecture was developed for use with the ProtoFlight Manipulator Arm (PFMA). Based upon the NASREM system design concept, the controller built for the PFMA provides localized position based force control, teleoperation, and advanced path recording and playback capabilities. The PFMA has six computer controllable degrees of freedom (DOF) plus a 7th manually indexable DOF, making the manipulator a pseudo 7 DOF mechanism. Joints on the PFMA are driven via 7 pulse width

modulated amplifiers. Digital control of the PFMA is implemented using a variety of single board computers. There were two major activities under the IRSS phase 4 study: (1) enhancement of the PFMA control system software functionality; and (2) evaluation of operating modes via a teleoperation performance study. These activities are described and results are given. Author

N92-14673# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
ARTIFICIAL NEURAL NETWORK APPROACHES IN GUIDANCE AND CONTROL
Sep. 1991 183 p Lecture series held in Monterey, CA, 8-9 Oct. 1991, in Kjeller, Norway, 14-15 Oct. 1991, and in Neubiberg, Fed. Republic of Germany, 17-18 Oct. 1991
(AGARD-LS-179; ISBN-92-835-0635-9) Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Ever increasing operational and technical requirements have led to highly integrated flight, guidance and control, and weapons delivery systems. The effective implementation of these functions makes the fusion and interpretation of sensor data and the multifunctional use of sensor information inevitable. Neural networks, consisting of parallel microcomputing elements, hold great promise for guidance, navigation, and control applications because of their ability to learn and acquire knowledge. The objective of this lecture series, sponsored by the Guidance and Control Panel of AGARD, was to present both the fundamentals of neural networks and a number of guidance, navigation, and control (GNC) applications. Some specific topics addressed include neural network architectures and design methodologies, target detection and recognition, vision systems, robots, and multisensor data fusion. For individual titles, see N92-14674 through N92-14682.

N92-14674# Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (Germany, F.R.). Intelligent Systems Div.
INTRODUCTION TO NEURAL COMPUTING AND CATEGORIES OF NEURAL NETWORK APPLICATIONS TO GUIDANCE, NAVIGATION AND CONTROL
Uwe K. Krogmann *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 24 p (For primary document see N92-14673 05-63)
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The creation of artificial neural networks (ANN) is directed towards the realization of capabilities and characteristics such as self-organization, learning, and associative memory. This is achieved by the particular structure of neural networks where a large number of simple processor elements are interconnected with uni-directional signal channels to single- or multi-layer networks. All processing elements are working in parallel as compared to one central, extremely efficient computer for sequential arithmetic and/or symbolic information processing. Artificial neural networks are not programmed but trained and learn like their biological paradigm, the brain. This is done by changing the intensity of the connections between processor elements and by generating or eliminating structural connections. A brief introduction to the architecture and functional characteristics of neural networks is presented. In addition, the general structure of guidance and control problems is described and the application of ANNs to guidance and control tasks is examined. Example applications relate to the fault tolerant measurement of the proprio-specific motion of an air vehicle and neural target classification. M.G.

N92-14675# General Dynamics/Electronics, San Diego, CA.
NEURAL NETWORK PARADIGMS
Patrick K. Simpson *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 33 p (For primary document see N92-14673 05-63)
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A review is given of what neural networks are and why they are so appealing. A typical neural network is introduced to illustrate several of the key features. Then the fundamental elements of a neural network such as input and output patterns, the processing element, connections, and threshold operations are described, followed by descriptions of neural network topologies, learning algorithms, and recall dynamics. Next, a taxonomy of neural networks is presented that uses two of their key characteristics: learning and recall. Finally, a comparison of neural networks and similar non-neural information processing methods is presented. Author

N92-14676# CompEngServ Ltd., Ottawa (Ontario).
A NEURAL NETWORK DESIGN METHODOLOGY: CONSIDERATIONS AND ISSUES FOR DESIGN AND PROJECT MANAGEMENT
B. Archie Bowen *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 20 p (For primary document see N92-14673 05-63)
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An artificial neural network (ANN) is a software implementation of a neural paradigm, and, therefore, such projects yield to many of the disciplines of software engineering. On the other hand, many issues that must be faced, as the project proceeds, are unique and require specialized knowledge to address. The concern here is mainly with the management of such projects. However, in order to propose the management issues, it seems necessary to understand, at least superficially, the process of the design and implementation of a neural-based system. Therefore, a proposal is given for a methodology for the conduct of a project involving the choice, design, and implementation of a neural-based system. The issues that should be considered and resolved at each step of the project are outlined. Based on this methodology, a project management plan can be put in place. Such a plan calls for a set of milestones and design reviews for various levels of management (and the customer) and a corresponding document set designed to prove a milestone has been reached, and finally, that the original requirements have been met. Author

N92-14677# Hecht-Nielsen Neurocomputer Corp., Inc., San Diego, CA.
PROCESSING COMPLEXITY OF TWO APPROACHES TO OBJECT DETECTION AND RECOGNITION
Todd Gutschow and Robert Hecht-Nielsen *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 12 p Prepared in cooperation with California Univ., San Diego, La Jolla (For primary document see N92-14673 05-63)
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The computational complexity of a processing function is a driving factor in the implementation of that function in an operational system. Artificial neural networks offer the potential for significant improvements in the computational complexity of a number of guidance and control functions. To illustrate such an improvement, a comparison is considered between two different approaches to object detection and recognition: a traditional approach using a wide field of view and constant spatial resolution throughout the image sensing and processing chain; and a foveal approach using a roving eyeball circularly symmetric sampling grid with a radially variant resolution in the processing chain. The rationale and characteristics of these two approaches are described and compared. Quantitative evaluations of the processing loads and data transfer rates are then carried out for both approaches. These processing requirements are then compared and the operational implications of this comparison are discussed. While the efficacy of the foveal approach is not explicitly discussed, references are provided to relevant research results in this regard. Author

N92-14678# Mimetics, Chatenay Malabry (France).
NEURAL NETWORKS FOR TARGET RECOGNITION
Bernard Angeniol *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 12 p (For

primary document see N92-14673 05-63)
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Neural networks are a very promising technique for target recognition, because of their adaptability, their fault tolerance, and their real time potential due to their parallelism. If, as in most of the applications of neural networks, data base availability, choice of preprocessing, and feature extraction are important to keep the amount of time necessary for learning within reasonable limits, the key factors for the success of the applications are multi-resolution recognition capabilities, invariance of recognition by translation, rotation, scaling, and movement detection capability. The integration of neural modules in weapon systems requires new validation processes, as well as a careful study to make the neural modules compatible with the sequence of functionalities of the system. Backpropagation is the most often used neural algorithm, because of its ability of extracting features. Various comparisons of performance with classical methods were made on some examples. Author

N92-14679# CompEngServ Ltd., Ottawa (Ontario).
VISION SYSTEMS FOR GUIDANCE AND CONTROL: A TUTORIAL OVERVIEW
B. Archie Bowen *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 14 p (For primary document see N92-14673 05-63)
Copyright Avail: NTIS HC/MF A09; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Vision systems are finding wide-spread use in such areas as autonomous robotics and in more mundane situations for the interpretation and/or identification of objects in images generated by various sensors. An overview of the various areas in which such systems have proven successful and and introduction to the underlying theory are presented. The human vision system seems to be composed of a set of pre-attentive filters located in the retina which do an immediate data reduction by computing a set of features (a feature vector). These features are transmitted to the brain for interpretation as images. Synthetic vision systems are based on the same functional decomposition of feature extraction followed by interpretation. The use of pre-attentive filters for synthetic vision systems had gained wide acceptance and produced some impressive results. The concept of pre-attentive filters is introduced and the Gabor and the Fourier-Mellin filter are shown as typical examples. Several types of neural nets, given the appropriate input data, can be trained as interpreters to classify, complete, and identify patterns. Several architectures are explored for these applications. The first class of applications exploits the mapping characteristics of neural networks. This ability leads to a set of applications in pattern classification, pattern completion, and pattern recognition. The second is in the more difficult field of object (target) recognition. Experimental results in image compression and target identification are drawn from the literature. It is suggested that the techniques for creating vision systems appear to be applicable to a very large class of problems not normally associated with seeing as we normally consider it. Author

N92-14680# British Aerospace Public Ltd. Co., Bristol (England).
NEURAL NETWORKS FOR MILITARY ROBOTS
W. A. Wright *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 22 p Sponsored in part by Procurement Executive, Ministry of Defence (England) (For primary document see N92-14673 05-63)
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A short review of mobile robotic research is presented through the use of three case studies. These case studies describe, in brief, current research undertaken at three establishments and indicate the role that neural networks are playing in this process. Hence, the impact that neural networks may have on the military environment is also indicated. Three case studies are chosen to illustrate the advantage, in terms of speed, compactness, and adaptability, of the use of these systems in what are defined as the three essential functional areas for mobile robot control: (1) localization; (2) path planning; and (3) obstacle avoidance. Author

N92-14681# General Dynamics/Electronics, San Diego, CA.
MULTISENSOR DATA FUSION AS APPLIED TO GUIDANCE AND CONTROL
Patrick K. Simpson *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 10 p (For primary document see N92-14673 05-63)
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Multisensor data fusion (MDF) is the synergistic application of data from several sources, typically sensors, toward a specific task. In the area of guidance and control, data fusion plays an important role. Several methods of applying neural networks to data fusion, including: self organizing hierarchical neural systems, multi layer error correction learning networks, and single layer pattern completion systems, are described. Application case studies will be examined to determine how researchers have applied neural networks to data fusion. Additionally, a discussion of feature representation and feature weighting will be provided. Author

N92-14682# Hecht-Nielsen Neurocomputer Corp., Inc., San Diego, CA.
ADVANCE NEURAL NETWORK ARCHITECTURES FOR GUIDANCE AND CONTROL
Todd Gutschow and Robert Hecht-Nielsen *In* AGARD, Artificial Neural Network Approaches in Guidance and Control Sep. 1991 12 p Prepared in cooperation with California Univ., San Diego, La Jolla (For primary document see N92-14673 05-63)
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Several advanced neural network architectures are expected to be of significant value in guidance and control. Three advanced neural network architectures (the graded learning network, the recurrent backpropagation network, and the hierarchical matched filter network) are discussed. Author

N92-14683# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
SYNTHESIS OF VISUAL MODULES FROM EXAMPLES: LEARNING HYPERACUITY
Manfred Fahle, Tomaso Poggio, and Shimon Edelman Jan. 1991 19 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124; N00014-88-K-0164; NSF IRI-87-19392)
(AD-A241159; AI-M-1271; CBIP-M-62) Avail: NTIS HC/MF A03 CSCL 06/1

For any given visual competence, it is tempting to conjecture a specific algorithm and a corresponding neural circuitry. It has been often implicitly assumed that this machinery may be hardwired in the brain. This extreme point of view, if taken seriously, may quickly lead to absurd consequences. The underlying reason for the spectacular performance of human subjects in these tasks is that the information sampled by the photoreceptors and relayed to the brain does contain the information necessary for precise localization of image features, since the spacing between photoreceptors and the eye's optics satisfy (in the fovea) the constraints of the sampling theorem. More specifically, it has been shown that, in principle, spatial mechanisms that account for grating resolution are sensitive enough to support hyperacuity-level performance. Furthermore, some of the hyperacuity tasks can be solved by detecting secondary cues such as luminance difference (as in the bisection task) or orientation (as in the detection of vertical vernier stimuli). The detailed structure of the neural circuitry that subserves the detection of these cues, or hyperacuity performance in other tasks is, however, unknown. GRA

N92-14684# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Psychology.
A MODEL OF THE SELF-EXPLANATION EFFECT

Kirt VanLehn, Randolph M. Jones, and Michelene T. Chi Sep. 1991 80 p
(Contract N00014-86-K-0678)
(AD-A241200; AIP-138) Avail: NTIS HC/MF A05 CSCL 05/7

Several investigation have taken protocols of students learning sophisticated skills, such as physics problem solving and Lisp coding, by studying examples and solving problems. These investigations uncovered the self-explanation effect: students who explain examples to themselves learn better, make more accurate self-assessments of their understanding and use analogies more economically while solving problems. This paper describes a computer model, named Cascade, that accounts for these findings. Explaining an example causes Cascade to acquire both domain knowledge and derivational knowledge. Derivational knowledge is used analogically to control search during problem solving. Domain knowledge is acquired when the current domain knowledge is incomplete and causes an impasse. If the impasse can be resolved by applying an overly general rule, then a specialization of the rule becomes a new domain rule. GRA

N92-14685# Navy Personnel Research and Development Center, San Diego, CA.
HUMAN-COMPUTER INTERFACES FOR TACTICAL DECISION MAKING, ANALYSIS, AND ASSESSMENT USING ARTIFICIALLY INTELLIGENT PLATFORMS. VOLUME 1: SOFTWARE DESIGN AND DATABASE DESCRIPTIONS FOR BATMAN AND ROBIN Final Report, Apr. 1989 - Aug. 1991
Pat-Anthony Federico, Randy R. Ullrich, Brian L. VandeWetering, Christel I. Tomlinson, and Dean J. Long Aug. 1991 146 p
(AD-A241509; NPRDC-TN-91-20-Vol-1) Avail: NTIS HC/MF A07 CSCL 23/2

This technical note contains the introduction, artificial intelligence techniques, software design, and database descriptions for the Battle-Management Assessment System and Raid Originator Bogie Ingress (BATMAN and ROBIN). These software systems are being developed to assess how well individuals can allocate, deploy, and manage air, surface, and/or subsurface tactical assets during simulated sea battles in many warfare areas. Together they form a desk-top, computer-based, performance-measurement system incorporating high resolution graphics, low level modelling, artificial intelligence techniques, to fill the gap between board games that are run in real or fictitious time with subjective assessment and inappropriate feedback and very expensive and manhour-intensive, mainframe-based simulators. Because of the nature of their generic software and independent databases, as well as the potential for incorporating different computer models, BATMAN and ROBIN can be used for a variety of functions: (1) training and testing tactical knowledge; (2) planning and decision aiding for tactical situations; (3) developing and evaluating tactics themselves; (4) analyzing and evaluating various tactical sensor, weapon, and communication systems; (5) frontending sophisticated tactical computer models and complex databases; (6) interfacing tactical artificial intelligent and expert systems; (7) generating rapidly scenarios for tactical trainers; (8) prototyping complicated scenarios for major wargaming systems; (9) orienting novices to facets of naval warfare; (10) evaluating tactical display symbologies and formats; and (11) providing an experimental environment for studying tactical decision making. GRA

N92-14686# Los Alamos National Lab., NM.
DISCRETE EVENT SIMULATION IN AN ARTIFICIAL INTELLIGENCE ENVIRONMENT: SOME EXAMPLES
D. J. Roberts and T. Farish 1991 8 p Presented at the International Conference on Frontiers in Innovative Computing for the Nuclear Industry, Jackson, WY, 15-18 Sep. 1991
(Contract W-7405-eng-36)
(DE92-000218; LA-UR-91-2971; CONF-9109110-8) Avail: NTIS HC/MF A02

Several Los Alamos National Laboratory (LANL) object-oriented discrete-event simulation efforts have been completed during the past three years. One of these systems has been put into production and has a growing customer base. Another (started two years earlier than the first project) was completed but has not yet been used. This paper will describe these simulation projects. Factors which were pertinent to the success of the one project, and to the failure of the second project will be discussed (success will be measured as the extent to which the simulation model was used as originally intended). DOE

N92-14687# Sandia National Labs., Albuquerque, NM.
CONVERTING A COMMERCIAL ELECTRIC DIRECT-DRIVE ROBOT TO OPERATE FROM JOINT TORQUE COMMANDS
P. F. Muir Jul. 1991 38 p
(Contract DE-AC04-76DP-00789)
(DE92-000611; SAND-91-1548) Avail: NTIS HC/MF A03

Many robot control algorithms for high performance in-contact operations including hybrid force/position, stiffness control and impedance control approaches require the command of the joint torques. However, most commercially available robots do not provide joint torque command capabilities. The joint command at the user level is typically position or velocity and at the control developer level is voltage, current, or pulse-width, and the torque generated is a nonlinear function of the command and joint position. To enable the application of high performance in-contact control algorithms to commercially available robots, and thereby facilitate technology transfer from the robot control research community to commercial applications, a methodology has been developed to linearize the torque characteristics of electric motor-amplifier combinations. A four degree of freedom Adept 2 robot, having pulse-width modulation amplifiers and both variable reluctance and brushless DC motors, is converted to operate from joint torque commands to demonstrate the methodology. The commercial robot controller is replaced by a VME-based system incorporating special purpose hardware and firmware programmed from experimental data. The performance improvement is experimentally measured and graphically displayed using three-dimensional plots of torque vs command vs position. The average percentage torque deviation over the command and position ranges is reduced from as much as 76 to below 5 pct. for the direct-drive joints 1, 2 and 4 and is cut by one half in the remaining ball-screw driven joint 3. Further, the torque deviation of the direct-drive joints drops below 2.5 pct. if only the upper 90 pct. of the torque range is considered. DOE

N92-14688# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MINIMALITY OF DYNAMIC INPUT-OUTPUT DECOUPLING FOR NONLINEAR SYSTEMS
H. J. C. Huijberts, H. Nijmeijer, and L. L. M. vanderWegen May 1991 14 p
(MEMO-960; ISSN-0169-2690; ETN-92-90493) Avail: NTIS HC/MF A03

The strong dynamic input-output decoupling problem for nonlinear systems is studied. Using an algebraic theory for nonlinear control systems, a compensator of minimal dimension that solves the decoupling problem is obtained for a dynamic input-output decouplable nonlinear system. ESA

N92-14689# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
L2-GAIN ANALYSIS OF NONLINEAR SYSTEMS AND NONLINEAR H INFINITY CONTROL
A. J. vanderSchaft (Arizona State Univ., Tempe.) May 1991 30 p
(MEMO-969; ISSN-0169-2690; ETN-92-90501) Avail: NTIS HC/MF A03

Previously obtained results on L2-gain analysis of smooth nonlinear systems are unified and extended using an approach based on Hamilton-Jacobi equations and inequalities, and their relation to invariant manifolds of an associated Hamiltonian vector field. Based upon these results, a rather complete treatment of the nonlinear analog of the standard H infinity optimal control problem by state feedback, which closely parallels the recently developed state space approach to linear H infinity control, is presented. The relation with H infinity control of the linearized system is dealt with. ESA

N92-14690# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
RELATIONS BETWEEN (H INFINITY) OPTIMAL CONTROL OF A NONLINEAR SYSTEM AND ITS LINEARIZATION
A. J. vanderSchaft May 1991 9 p
(MEMO-970; ISSN-0169-2690; ETN-92-90502) Avail: NTIS HC/MF A02

Some basic connections between H infinity control of a nonlinear control system and H infinity control of its linearization were previously shown. A key argument was that the existence and parametrization, at least locally, of the stable invariant manifold of a certain Hamiltonian vector field is determined by the Hamiltonian matrix corresponding to the linearized problem. Using the same methodology, a quick proof of the fact that a nonlinear optimal control problem is locally solvable if the associated LQ problem is solvable is given. This was proved before by Lukes under much stronger conditions. ESA

N92-14691# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
SUPER-OPTIMIZATION OF FOUR-BLOCK PROBLEMS VIA THE EQUALIZER PRINCIPLE
P.-O. Nyman Apr. 1991 38 p
(MEMO-957; ISSN-0169-2690; ETN-92-90350) Avail: NTIS HC/MF A03

Superoptimization of four block problems via a dimension reducing technique based on the so called equalizer principle is addressed. The reduction together with ordinary H infinity optimization provides an algorithm for computing super optimal solutions for a large class of four block problems. ESA

N92-14692# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ADAPTIVE PD+ CONTROL OF RIGID ROBOT MANIPULATORS
H. Berghuis, P. Loehnberg, and H. Nijmeijer Apr. 1991 11 p
Sponsored by the Netherlands Technology Foundation
(MEMO-958; ISSN-0169-2690; ETN-92-90351) Avail: NTIS HC/MF A03

Two adaptive trajectory tracking controllers for rigid robot manipulators are presented. These controllers are characterized by three parts, a linear PD part, a nonlinear PD part, and a nonlinear model based part. Asymptotic trajectory tracking can be guaranteed for the closed loop system under quite general conditions on the linear controller gains. Both controllers have the property that they reduce to gravitation compensation and PD control in the particular case of position control. An interesting consequence of this property is that the presented controllers are robust to noise on the velocity measurements, which usually causes parameter drift. This feature of the controllers is demonstrated in a simulation study of a 2 DOF robot system, in which it is also shown that a well known adaptive tracking controller from literature suffers from this parameter drift. ESA

N92-14693# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
NECESSARY AND SUFFICIENT CONDITIONS OR OPTIMAL FIXED-ORDER DYNAMIC COMPENSATION OF LINEAR DISCRETE-TIME SYSTEMS
W. L. deKoning and H. deWaard 1991 18 p
(Grant STW-DWI-77-1397)
(Rept-91-14; ISSN-0922-5641; ETN-92-90394) Copyright Avail: NTIS HC/MF A03

The optimal fixed order dynamic compensation problem is considered in the case of linear discrete time systems with quadratic criteria. Necessary and sufficient conditions for the existence of a unique optimal stabilizing compensator of given order are derived. A test, explicit in the system matrices, is provided to determine if a given system satisfies the necessary and sufficient conditions. ESA

N92-14694*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
CEREBELLAR MODELS OF ASSOCIATIVE MEMORY: THREE PAPERS FROM IEEE COMPCON SPRING 1989
Michael R. Raugh, ed. Mar. 1989 24 p The 34th IEEE Computer Society International Conference was held in San Francisco, CA, 27 Feb. - 3 Mar. 1989
(Contract NCC2-408)
(NASA-CR-188838; NAS 1.26:188838; RIACS-TR-89-11) Avail: NTIS HC/MF A03 CSCL 09B

Three papers are presented on the following topics: (1) a cerebellar-model associative memory as a generalized random-access memory; (2) theories of the cerebellum - two early models of associative memory; and (3) intelligent network management and functional cerebellum synthesis. For individual titles, see N92-14695 through N92-14697.

N92-14695*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
A CEREBELLAR-MODEL ASSOCIATIVE MEMORY AS A GENERALIZED RANDOM-ACCESS MEMORY
Pentti Kanerva *In its* Cerebellar Models of Associative Memory: Three Papers from IEEE COMPCON Spring 1989 Mar. 1989 p 1-7 (For primary document see N92-14694 05-63)
Avail: NTIS HC/MF A03 CSCL 09B

A versatile neural-net model is explained in terms familiar to computer scientists and engineers. It is called the sparse distributed memory, and it is a random-access memory for very long words (for patterns with thousands of bits). Its potential utility is the result of several factors: (1) a large pattern representing an object or a scene or a moment can encode a large amount of information about what it represents; (2) this information can serve as an address to the memory, and it can also serve as data; (3) the memory is noise tolerant--the information need not be exact; (4) the memory can be made arbitrarily large and hence an arbitrary amount of information can be stored in it; and (5) the architecture is inherently parallel, allowing large memories to be fast. Such memories can become important components of future computers. Author

N92-14696*# National Inst. of Standards and Technology, Gaithersburg, MD. Robot Systems Div.
THE MARR AND ALBUS THEORIES OF THE CEREBELLUM: TWO EARY MODELS OF ASSOCIATIVE MEMORY
James S. Albus *In* Research Inst. for Advanced Computer Science, Cerebellar Models of Associative Memory: Three Papers from IEEE COMPCON Spring 1989 Mar. 1989 p 8-13 (For primary document see N92-14694 05-63)
Avail: NTIS HC/MF A03 CSCL 09B

The Marr and Albus theories of the cerebellum are compared and contrasted. They are shown to be similar in their analysis of the function of the mossy fibers, granule cells, Golgi cells, and Purkinje cells. They both predict motor learning in the parallel fiber synapses on the Purkinje dendrites mediated by concurrent climbing fiber input. This prediction has been confirmed by experimental evidence. In contrast, Marr predicts these synapses would be facilitated by learning, while Albus predicts they would be weakened. Experimental evidence confirms synaptic weakening. Author

N92-14697*# Hewlett-Packard Labs., Palo Alto, CA.
INTELLIGENT NETWORK MANAGEMENT AND FUNCTIONAL CEREBELLUM SYNTHESIS
Egon E. Loebner *In* Research Inst. for Advanced Computer Science, Cerebellar Models of Associative Memory: Three Papers from IEEE COMPCON Spring 1989 Mar. 1989 p 14-19 (For primary document see N92-14694 05-63)
Avail: NTIS HC/MF A03 CSCL 09B

Transdisciplinary modeling of the cerebellum across histology, physiology, and network engineering provides preliminary results at three organization levels: input/output links to central nervous system networks; links between the six neuron populations in the cerebellum; and computation among the neurons of the

populations. Older models probably underestimated the importance and role of climbing fiber input which seems to supply write as well as read signals, not just to Purkinje but also to basket and stellate neurons. The well-known mossy fiber-granule cell-Golgi cell system should also respond to inputs originating from climbing fibers. Corticonuclear microcomplexing might be aided by stellate and basket computation and associate processing. Technological and scientific implications of the proposed cerebellum model are discussed. Author

N92-14698# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
A NEW DEVICE FOR THE SYNTHESIS PROBLEM OF OPTIMAL CONTROL OF ADMISSION TO AN M/M/c QUEUE
J. P. C. Blanc, P. R. deWaal, P. Nain, and D. Towsley (Massachusetts Univ., Amherst.) Jan. 1991 29 p
(Contract N00014-87-K-0304; NSF ASC-88-02764)
(CWI-BS-R9101; ETN-92-90467) Copyright Avail: NTIS HC/MF A03

The problem of finding an optimal admission policy to an M/M/c queue with customers with deadlines is addressed. There are two streams of customers (customers of class 1 and 2) that are generated according to independent Poisson processes with constant arrival rates. All service times are exponentially distributed with a class independent service rate. Upon arrival a class 1 customer may be admitted or rejected, while incoming class 2 customers are always admitted. Associated with the nth class 1 customer is a deadline, D sub n, by which it must complete service where (D sub n) upper bound infinity, lower bound 1, is a sequence of i.i.d. random variables. The throughput of class 1 customers that complete their service before their deadline (usually referred to as goodput) is addressed, and the aim is to determine an admission control that maximizes this throughput. At each decision epoch the controller is assumed to have available to it the complete history of the total queue length process as well as all of the past decisions that have been made up to that epoch. It is shown that for a large class of deadline distributions, there exists a stationary admission policy of a threshold type that maximizes a discounted cost function (for small discount factors) that corresponds to the discounted goodput of customers that make their dealine. The proof relies on a new device that consists of a partial construction of the solution of the dynamic programming equation. In addition, a threshold admission control that maximizes the long run average problem (i.e., maximizes the goodput) is shown to exist. The proposed method is of independent interest and should apply to many queuing control problems. ESA

N92-14699# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
FINITE-DIMENSIONAL ROBUST CONTROLLER DESIGNS FOR DISTRIBUTED PARAMETER SYSTEMS: A SURVEY
Ruth F. Curtain 1991 15 p Presented at Workshop on Robust Control, Tokyo, Japan, 24-25 Jun. 1991
(W-9104; ETN-92-90527) Avail: NTIS HC/MF A03

Although there has been much research on the stabilization of distributed parameter systems, the theory usually produces infinite dimensional controllers. For example, the theory of linear quadratic control produces a state feedback law in which both the state and the gain operator are infinite dimensional. To produce an implementable finite dimensional controller entails approximating both this gain operator and the state, which is a complicated numerical procedure and sometimes (in the case of unbounded inputs) difficult to justify theoretically. The continuing popularity of this approach is somewhat surprising, since there exist several direct methods of designing finite dimensional controllers for infinite dimensional systems. The first finite dimensional compensator design was a state space approach in 1981 and since then there have been many others. In particular, there exist various frequency domain theories for designing finite dimensional controllers which are robust to certain types of uncertainties or which satisfy other additional performance objectives. A survey and comparison of ways of designing finite dimensional controllers for infinite dimensional systems with the emphasis on robust controllers is presented. ESA

N92-14700*# Bendix Field Engineering Corp., Columbia, MD.
USING C TO BUILD A SATELLITE SCHEDULING EXPERT SYSTEM: EXAMPLES FROM THE EXPLORER PLATFORM PLANNING SYSTEM
David R. McLean, Alan Tuchman, and William J. Potter [1991] 11 p Previously announced in IAA as N91-22774
(Contracts NAS5-31000; NAS5-27772)
(NASA-CR-189247; NAS 1.26:189247) Avail: NTIS HC/MF A03 CSCL 09B

A C-based artificial intelligence (AI) development effort which is based on a software tools approach is discussed with emphasis on reusability and maintainability of code. The discussion starts with simple examples of how list processing can easily be implemented in C and then proceeds to the implementations of frames and objects which use dynamic memory allocation. The implementation of procedures which use depth first search, constraint propagation, context switching, and blackboard-like simulation environment are described. Techniques for managing the complexity of C-based AI software are noted, especially the object-oriented techniques of data encapsulation and incremental development. Finally, all these concepts are put together by describing the components of planning software called the Planning And Resource Reasoning (PARR) Shell. This shell was successfully utilized for scheduling services of the Tracking and Data Relay Satellite System for the Earth Radiation Budget Satellite since May of 1987 and will be used for operations scheduling of the Explorer Platform in Nov. of 1991. Author

N92-13987# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
SPACE ROBOTICS
G. M. T. DEleuterio, P. C. Hughes, G. B. Sincarsin, V. Pugliese, T. Cherpillod, J. Carusone, D. P. W. Graham, F. Naccarato, C. Sallaberger, and I. Sharf et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 98-100
(For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-14701# Academy of Sciences (USSR), Moscow. Nauchno-Issledovatelskij Inst. Yadernoj Fiziki.
QUARK-BIQUARK BARYON STRUCTURE: LEPTONIC DECAY OF BARYONS IN QCD AND IN UNITARY SYMMETRY
A. I. Anoshin, L. Gelmi, V. S. Zamiralov, and S. N. Lepshokov 1990 25 p In RUSSIAN
(DE91-634556; NIIYAF-MGU-90-2-148) Avail: NTIS HC/MF A03

For baryons 1/2(exp +) of SU(6) 70-plet, the constants of lepton transitions G(sub A)(sup B) in a quark-biquark model and in the unitary symmetry model are obtained. It is shown that F- and D-tensor structures of axially-vector weak baryon current J(sub A) are related to a certain quark structure of the baryons. For the constants of neutral transitions in SU(6) and charged transitions in SU(4)Ga(sub A)(sup B) the Borel sum rules are plotted. It is shown that they have the structure reflecting the presence of F- and D- bonds in the current J(sub A). DOE

N92-14702# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
METHOD OF THE PROJECTION OPERATORS AND q-ANALOG OF THE QUANTUM ANGULAR MOMENTUM THEORY. 1: CLEBSCH-GORDAN COEFFICIENTS AND IRREDUCIBLE TENSOR OPERATORS

Yu. F. Smirnov, V. N. Tolstoj, and Yu. I. Kharitonov 1990 36 p In RUSSIAN; ENGLISH summary
(DE91-635999; LIYaF-1607) Avail: NTIS HC/MF A03

The structure of the quantum algebra su(sub q)(2) and the properties of its irreducible representation are considered. The projection operator is constructed as a power series from generators of the su(sub q)(2) algebra. The explicit analytical formula for q-analog of Clebsch-Gordan coefficients is derived using this projector. Their symmetry properties are discussed. The algebraic tables of these coefficients are given. The tensor operators are introduced and the Wigner-Eckart theorem is proved. DOE

N92-14703# California Univ., Berkeley. Lawrence Berkeley Lab.
RECENT DEVELOPMENTS IN THE VIRASORO MASTER EQUATION
M. B. Halpern 3 Sep. 1991 17 p Presented at the Strings and Symmetries Conference, Stony Brook, NY, 20-25 May 1991
(Contract DE-AC03-76SF-00098)
(DE92-000811; LBL-31192; CONF-9105113-3; UCB-PTH-91/43) Avail: NTIS HC/MF A03

The Virasoro master equation collects all possible Virasoro constructions which are quadratic in the currents of affine Lie groups. The solution space of this system is immense, with generically irrational central charge. Solutions which have so far been observed are generically unitary. Other developments reviewed include the exact C-function, the superconformal master equation and partial classification of solutions by graph theory and generalized graph theories. DOE

N92-14704# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj Fiziki.
HAMILTONIAN REDUCTION OF WESS-ZUMINO-WITTEN THEORY FROM THE POINT OF VIEW OF BOSONIZATION
A. Gerasimov, A. Morozov (Academy of Sciences, USSR, Moscow), and A. Marshakov 1989 9 p
(DE91-634069; ITEP-139-89) Avail: NTIS HC/MF A02

Representation of Kac-Moody algebra in terms of free fields as applied to the minimal models is considered. Hamiltonian reduction of the Wess-Zumino-Witten model is performed from the viewpoint of bosonization, consisting in expressing many-loop correlators through free field correlators on Riemann surface. DOE

N92-14705# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
SCALING PROPERTIES OF BAND RANDOM MATRICES
G. Gasati, L. Molinari, and F. M. Izrailev 1990 15 p
(DE91-635977; IYaF-90-15) Avail: NTIS HC/MF A03

It is shown on the basis of numerical data that the normalized localization length of eigenvectors of band random matrices follows a scaling law. The scaling parameter is b(exp 2)/N, where b measures the bandwidth, and N is the size of the matrix. DOE

N92-14706# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
SYMMETRICALLY-RECURSION OPERATOR IN BI-LAGRANGIAN THEORIES
F. A. Lunev 1989 10 p In RUSSIAN
(DE91-623519; NIIYaF-MGU-89-32-109) Avail: NTIS HC/MF A02

Theorem about the existence of symmetrically-recursion operator in bi-Lagrangian theories has been proposed. The theorem is valid for a wide range of equations with local and nonlocal Lagrangians, with commutating and anticommutating variables. Symmetrically-recursion operator and corresponding higher symmetries and higher conservation laws in classical electrodynamics have been constructed as an example. DOE

N92-14707# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
SOME PHYSICAL APPLICATIONS OF NONSTANDARD LOGICAL SYSTEMS
N. B. Bogdanova and B. F. Kostenko 1989 10 p In RUSSIAN; ENGLISH summary
(DE91-628005; JINR-R-5-89-403) Avail: NTIS HC/MF A02

A four-valued propositional calculus with two fuzzy truth values which allows the describtion of physical phenomena with taking into account the Heisenberg uncertainty relation is suggested. It is shown that this logic complies with axioms and inference rules of the classical two-vaued logic Cl2 and is characterized by the equivalence classes algebra which is isomorphous to the algebra of Cl2. The meaning of the main logical operations is discussed in detail. DOE

N92-14708# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
POTENTIAL RECONSTRUCTION FROM R-MATRIX RESONANCE POSITIONS AND REDUCED WIDTHS
I. V. Amirkhanov, I. V. Puzynin, T. P. Puzynina, and B. N. Zakhariev 1989 6 p Submitted for publication
(DE91-628029; JINR-E-4-89-312) Avail: NTIS HC/MF A02

The first example is given of numerical reconstruction of the potential shape from the spectral data in the frame of the R-matrix scattering theory using the Bargmann-type analytical solutions. A simple multi-channel model of the inverse problem is proposed for the investigating the convergence of reconstruction procedure for the interaction matrix, which couples the channels. DOE

N92-14709# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
NEW EXAMPLES OF CONTINUUM GRADED LIE ALGEBRAS
M. V. Savelev and A. M. Vershik (Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Leningrad, USSR) 1989 16 p
(DE91-623480; IFVE-OTF-89-193) Avail: NTIS HC/MF A03

Several new examples of continuum graded Lie algebras which provide an additional elucidation of these algebras are given. Here, in particular, the Kac-Moody algebras, the algebra S sub 0 Diff T(exp 2) of infinitesimal area-preserving diffeomorphisms of the torus T(exp 2), the Fairlie, Fletcher and Zachos sine-algebras, etc., are described as special cases of the cross product Lie algebras. DOE

N92-14710# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
EXPANSION OF THE TRANSFORMATIONS OF RECIPROCAL RADIUS-VECTORS INTO A SET OF TRANSFORMATIONS BELONGING TO THE WEYL GROUP
G. A. Kotelnikov 1989 7 p In RUSSIAN; ENGLISH summary
(DE91-623503; IAE-4948-1) Avail: NTIS HC/MF A02

It is shown that the transformations of reciprocal radius-vectors can be expanded into four sets of transformations belonging to the Weyl group. The formulas of the transformation of the components of electromagnetic field, current and charge densities as well as potentials for the case of two-charge electrodynamics are given. The conform dimensionality is 0 for the electromagnetic charges, -1 for the potentials, -2 for the fields, -3 for the current and charge densities, -4 for the difference of the squares of fields. The electromagnetic charges are transformed so that if one of them is scalar, the other is pseudoscalar. The difference in their transformation properties means that the electric charge will not interact with the fields of the magnetic charge and vice versa. This can be a reason of the unsuccessful attempts to register the Dirac monopole. DOE

N92-14711# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
THE CONNECTIVITY OF THE LEAF-EXCHANGE SPANNING TREE GRAPH OF A GRAPH
H. J. Broersma and Li Xueliang (Xinjiang Univ., Urumchi, China) May 1991 11 p

(MEMO-959; ISSN-0169-2690; ETN-92-90492) Avail: NTIS HC/MF A03

Let G be a connected (multi)graph. The leaf exchange spanning tree graph (T sub l) (G) of G, with vertex and edge sets is defined. (T sub l) (G) is a spanning subgraph of the so-called spanning tree graph of G, and of the adjacency spanning tree graph of G, which were studied by several authors. A variation on the leaf exchange spanning tree graph appeared in recent work on basis graphs of branching greedoids. The graphs which have a connected leaf exchange spanning tree graph are characterized and a lower bound on the connectivity of (T sub l) (G) for a connected graph G is given. ESA

N92-14712# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

CONCEPTUAL DATA MODELS VERSUS KNOWLEDGE GRAPHS

Cornelis Hoede and Maurice A. W. Houtsma May 1991 21 p (MEMO-962; ISSN-0169-2690; ETN-92-90495) Avail: NTIS HC/MF A03

The power of knowledge graphs to express conceptual data models is explored. Since knowledge graphs are intended to capture almost anything, there should be no problems in the translation from a conceptual data model to a knowledge graph. In particular, this translation is used as a means of tuning the meaning of links as they are used in knowledge graphs. The inverse process is also investigated, that is, how the essential concepts in conceptual data models come forward from a knowledge graph. In this way, knowledge graphs may be used to construct a conceptual data model from a given textual description of a particular application. ESA

N92-14713# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

DEGENERATE POLYNOMIAL PATCHES OF DEGREE 4 AND 5 USED FOR GEOMETRICALLY SMOOTH INTERPOLATION IN R3

Marian Neamtu and P. R. Pfluger (Amsterdam Univ., Netherlands) May 1991 35 p Sponsored by Netherlands Foundation of Mathematics and Netherlands Organization for the Advancement of Research (MEMO-963; ISSN-0169-2690; ETN-92-90496) Avail: NTIS HC/MF A03

The problem of interpolating scattered three dimensional (R 3 (the set of Real numbers in three dimensions)) data by a geometrically smooth surface is considered. A completely local method based on employing the so called degenerate triangular Bernstein-Bezier patches is proposed. An analysis of these patches is given and some numerical experiments with quartic and quintic patches are presented. ESA

N92-14714# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

STOERMER-COWELL- AND RELATED METHODS FOR THE NUMERICAL SOLUTION OF SECOND ORDER PERIODIC INITIAL VALUE PROBLEMS FOR ODE'S. 1: SURVEY OF METHODS

Jan F. Frankena 21 May 1991 47 p (MEMO-966; ISSN-0169-2690; ETN-92-90497) Avail: NTIS HC/MF A03

Several numerical methods for second order Ordinary Differential Equations (ODES) with given initial values, that possess periodic solutions, are considered. Stoermer-Cowell methods are related to the Gauss-Jackson method and other second sum methods (and analogously, Adams-Bashforth-Moulton methods to first sum methods). Some more or less recent methods are described. ESA

N92-14715# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

ON THE SYMBOLIC CALCULATION OF PERIODIC ORBITS FOR THE LOGISTIC MAP

Martin Streng and Ruud vanDamme May 1991 11 p (MEMO-965; ISSN-0169-2690; ETN-92-90498) Avail: NTIS HC/MF A03

It is well known that explicit expressions exist for periodic orbits of the logistic map for periods 1 up to 4. It is shown that already for the periodic orbits of period 5 such expressions do not exist. However, for any period it is possible to obtain polynomial equations for the orbit invariants such as for example, the derivative of the nth iterate of the map. ESA

N92-14716# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

ON APPROXIMATION AND INTERPOLATION OF CONVEX FUNCTIONS

Marian Neamtu 13 May 1991 11 p Presented at the NATO-ASI Conference on Approximation Theory, Spline Functions, and Applications, Maratea, Italy, 29 Apr. - 9 May 1991 Sponsored by Netherlands Foundation of Mathematics and Netherlands Organization for the Advancement of Research (MEMO-967; ISSN-0169-2690; ETN-92-90499) Avail: NTIS HC/MF A03

Some negative results concerning the convexity preserving approximation and interpolation of multivariate functions are presented. The approximation which is proved to be based on both interpolation and local operators cannot be convexity preserving, provided the approximation space is (locally) finite dimensional. In both cases, the assumption of the linearity of the approximation operator and the assumption that the approximation space is a space of piecewise polynomials can be dispensed with. Some consequences for the construction of shape preserving approximations are discussed. ESA

N92-14717# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

A NOTE ON MAXIMAL SPANNING TREE GAMES AND PRIM'S ALGORITHM

U. Faigle May 1991 8 p (MEMO-968; ISSN-0169-2690; ETN-92-90500) Avail: NTIS HC/MF A02

A cooperative game is considered where the players are represented by the vertices, V, of a complete graph with nonnegative edge weights and the value of a coalition, S, is a subset of V is given by the value of a maximal spanning tree in the subgraph induced by S. The core of this game is shown to be nonempty. A core vector can be constructed while Prim's algorithm is applied to the graph. ESA

N92-14718# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

GENERALIZING MULTIQUADRATIC INTERPOLATION: UNIVARIATE CASE

Bas J. Hogervorst and Ruud vanDamme Jun. 1991 11 p (MEMO-974; ISSN-0169-2690; ETN-92-90506) Avail: NTIS HC/MF A03

One way to construct a manifold which interpolates data values given in a number of scattered data points is by using Hardy's multiquadratics. It is known that if the data comprise a finite domain this method has quadratic convergence in the interior. However, on the whole domain in general only linear convergence occurs. Two different methods that deal with the boundary effects in such a way that it enforces quadratic convergence on the considered domain are proposed. The starting point is the analysis of certain integral equations whose solutions are closely related to solutions of the interpolation problem. ESA

N92-14719# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

DERIVATIVE GENERATION IN PIECEWISE CUBIC C(1)-INTERPOLATION

Bernd Mulansky and Ines Sello (Technische Univ., Dresden, German D.R.) Jun. 1991 13 p Sponsored in part by Netherlands Organization for the Advancement of Research

(MEMO-976; ISSN-0169-2690; ETN-92-90508) Avail: NTIS HC/MF A03

A method for the derivative generation in univariate cubic C(1) spline interpolation is described. The approach is based on the Bernstein-Bezier representation of piecewise polynomials. The cubic C(1) spline interpolant is obtained by a minimum norm correction of the B ordinates of the piecewise linear interpolant in order to get the required C(1) smoothness. The approach results in a simple formula for the generation of the derivatives at the knots. They are computed as weighted means of the two slopes between the considered data point and its neighbors. Several numerical tests and comparisons with other methods are presented, especially for rapidly varying data. In view of its simplicity, the method performs surprisingly well on some practically relevant data sets known from literature on shape preserving interpolation. ESA

N92-14720# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

AN IMPROVED APPROACH TO AUTOMATIC ERROR CUMULATION CONTROL

J. H. J. Molenkamp, V. V. Goldman, and J. A. vanHulzen Jul. 1991 14 p Presented at the 1991 International Symposium on Symbolic and Algebraic Computation, Bonn, Germany, 15-17 Jul. 1991 Submitted for publication

(Memo-INF-91-61; ISSN-0924-3755; ETN-92-90519) Avail: NTIS HC/MF A03

For evaluation of arithmetical expressions using multiple precision floating point arithmetic, a method is given to automatically perform error cumulation control prior to the actual computations. Individual errors and their effects are identified, and it is shown how to compute these effects efficiently via automatic differentiation. In this approach these effects are used to determine which precisions have to be chosen during the real computations, in order to limit error cumulation to admissible, user chosen error bounds. ESA

N92-14721# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.

CENSUS TECHNIQUES ON RELATIVIZED SPACE CLASSES

Edith Spaan Apr. 1991 14 p

(ITLI-CT-91-06; ISSN-0924-8374; ETN-92-90521) Avail: NTIS HC/MF A03

Recent results have focused the attention of research in structural complexity theory to the development and application of census techniques. Several new techniques with which the equality of SPACE(s)(sup NTME(t)) classes in the sense of Ladner and Lynch can be compared to known classes are developed. ESA

N92-14722# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.

THE INCOMPLETE DATABASE

Karen L. Kwast May 1991 19 p Presented at the 12th International Joint Conference on Artificial Intelligence Submitted for publication

(ITLI-CT-91-07; ISSN-0924-8374; ETN-92-90522) Avail: NTIS HC/MF A03

The introduction of nulls (unknown values) into the relational database calls for an extension of the theoretical foundation of the database model. Nulls are alien to classical logic, in which the relational database model is rooted. This has led to all sorts of counterintuitive ad hoc solutions, reasonable in one place, but awkward in others. A sound model theoretical foundation of nulls in a relational database based on modal logic is presented. A modal interpretation of queries is easy to comprehend and intuitively correct. Partial interpretations, which are to be preferred from a computational point of view, are inadequate for arbitrary queries. Formulas that have an identical partial and modal interpretation are called safe. Safety guarantees on the one hand that the partial answer is meaningful and on the other that the modal interpretation is finitely computable. The suitability of modal logic to model nulls is illustrated by a short discussion of the effect of nulls on database integrity. ESA

N92-14723# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.

QUASI-INJECTIVE REDUCTIONS

Lane A. Hemachandra (Rochester Univ., NY.) and Edith Spaan 24 Jul. 1991 12 p

(Grants NSF CCR-89-57604; NWO-SIR-13-785)

(ITLI-CT-91-11; ISSN-0924-8374; ETN-92-90526) Avail: NTIS HC/MF A03

A reduction is said to be quasi-injective if no element of the range is mapped to by infinitely many elements. The connection between degree of injectivity and strength of reduction is studied via two natural families of quasi injective reductions. In particular, the relative strengths of polynomial time f(n) to 1 reductions, and of polynomial time k to k' reductions are completely determined. ESA

N92-14724# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

FURTHER RESULTS IN THE TRIANGULAR DECOUPLING PROBLEM FOR NONLINEAR SYSTEMS

A. C. Ruiz and H. Nijmeijer Mar. 1991 9 p Presented at the European Control Conference, Grenoble, France, 1991 Submitted for publication Sponsored by CONACyT

(MEMO-941; ISSN-0169-2690; ETN-92-90334) Avail: NTIS HC/MF A02

The Triangular Decoupling Problem (TDP) for nonlinear control systems is addressed. A set of geometric conditions for the solvability of the TDP is derived and the connection with the dynamic input output decoupling problem is studied. It is common practice to solve synthesis problems for nonlinear control systems about an equilibrium point by solving the same problem for the associated linearized system. Here, it is shown that a solution of the TDP for the associated linearized system does not correspond to the first order approximation of a solution for the original nonlinear TDP. Simulations on a simple example illustrate these results. ESA

N92-14725# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

ON RADIAL SPLINE INTERPOLATION

Bas J. Hogervorst Mar. 1991 24 p

(MEMO-948; ISSN-0169-2690; ETN-92-90341) Avail: NTIS HC/MF A03

The problem of constructing a manifold which interpolates data values given in a number of scattered data points is considered. One way to obtain interpolants is by using radial basis functions. A short introduction to the theory is given. It is shown that by a slight modification, a method which can be interpreted more easily is obtained. Also, a generalization of this idea can easily be derived. ESA

N92-14726# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

N-DIMENSIONAL LINE DIGRAPHS

Li Xueliang and Zhang Fuji (Xinjiang Univ., Urumchi, China) Mar. 1991 16 p

(Memo-949; ISSN-0169-2690; ETN-92-90342) Avail: NTIS HC/MF A03

The ordinary iterated line digraph is called a one dimensional line digraph. The concept of an n dimensional line digraph, a natural generalization, is introduced. Some results on the one dimensional case are generalized to the n dimensional case. ESA

N92-14727# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

MINIMUM BASIS GRAPHS OF WEIGHTED MATROIDS

Zhang Fuji, Li Xueliang, and Guo Xiaofeng (Xinjiang Univ., Urumchi, China) Apr. 1991 11 p

(MEMO-950; ISSN-0169-2690; ETN-92-90343) Avail: NTIS HC/MF A03

The concept of the minimum basis graph for a weighted matroid, a natural generalization of the minimum spanning tree graph for a weighted graph, is introduced and it is proved that such a graph is again a matroid basis graph. Therefore, it has many satisfactory properties; for example, it a pancyclic graph and its connectivity equals its minimum degree. Some previous results for weighted graphs are generalized to those for weighted matroids. ESA

N92-14728# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

HARD GRAPHS FOR THE MAXIMUM CLIQUE PROBLEM 2

Cornelis Hoede and Li Xueliang (Xinjiang Univ., Urumchi, China) Mar. 1991 9 p

(MEMO-951; ISSN-0169-2690; ETN-92-90344) Avail: NTIS HC/MF A02

The maximum clique problem is studied for graphs that do not have an induced subgraph P sub 4, an induced subgraph K sub (1,3) + e or do not have an induced subgraph isomorphic to C sub 4 or 2K sub 2. In all three cases a polynomial algorithm is given. These results extend results for other classes of graphs that do not contain certain induced subgraphs on four vertices. ESA

N92-14729# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

HOMOMORPHISMS ON N-DIMENSIONAL LINE DIGRAPHS

Li Xueliang and Zhang Fuji (Xinjiang Univ., Urumchi, China) Apr. 1991 15 p

(Memo-952; ISSN-0169-2690; ETN-92-90345) Avail: NTIS HC/MF A03

The ordinary iterated line digraph is called a one dimensional line digraph. The concept of an n dimensional line digraph, a natural generalization of the above, is introduced. A natural isomorphism from the set of homomorphisms of a digraph onto a set of so-called arc preserving homorphisms is proved. This result generalizes previous results on de Bruijn-Good graphs. ESA

N92-14730# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

FOURIER TRANSFORMATION IN AN ALGEBRA OF GENERALIZED FUNCTIONS

Martin Damsma Apr. 1991 18 p Sponsored by the Netherlands Organization for Scientific Research

(MEMO-954; ISSN-0169-2690; ETN-92-90347) Avail: NTIS HC/MF A03

The algebra of generalized functions as introduced by J. F. Colombeau possesses a Fourier transformation. This Fourier transformation however is not surjective, and it does not satisfy all the usual properties of Fourier transformation. The definition of the Fourier transformation satisfactorily using a new definition of the algebra is shown. ESA

N92-14731# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

A SINGULAR NONLINEAR VOLTERRA INTEGRAL EQUATION

B. H. Gilding Apr. 1991 41 p

(Memo-955; ISSN-0169-2690; ETN-92-90348) Avail: NTIS HC/MF A03

A given integral equation is shown to have none, one or an uncountable number of solutions. Subsequently, it is shown that even if there is an infinite number of solutions, there is one which is maximal. Moreover, a recipe for constructing this particular solution is provided. This permits the establishment of necessary and sufficient conditions for the existence of a solution. Comparison principles for solutions of the equation with different sets of coefficients are presented. These analyses demonstrate that the equation may indeed have none, one or an uncountable number of solutions. The behavior of the maximal solution in the neighborhood of the origin is investigated. ESA

N92-14732# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

SEPARATRIX CYCLES AND MULTIPLE LIMIT CYCLES IN A CLASS OF QUADRATIC SYSTEMS

Andre Zegeling 1990 57 p

(Rept-90-84; ISSN-0922-5641; ETN-92-90372) Copyright Avail: NTIS HC/MF A04

The bifurcation sets in a class of quadratic systems are investigated. A unique bifurcation surface of a form corresponding to a separatrix cycle is proven to exist. The structure of this cycle is determined for the different cases appearing in the class of quadratic systems. At least one bifurcation surface corresponding to a semistable limit cycle is proven to exist. The asymptotic behavior of these two bifurcation surfaces is analyzed. This leads to problems related to singular perturbed differential equations. The qualitative behavior of solutions in quadratic systems with three saddles and one antisaddle for large values of the parameters is proved to be governed by the class of quadratic systems. ESA

N92-14733# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

GENERALIZATION OF TRAVELTIME INVERSION

Gerard C. Herman 1991 22 p Presented at the 60th Annual SEG Meeting, San Francisco, CA, Sep. 1990

(Rept-91-13; ISSN-0922-5641; ETN-92-90393) Copyright Avail: NTIS HC/MF A03

A nonlinear inversion method especially suited for the determination of global velocity models is presented. In a certain sense, it can be considered as a generalization of methods, based on traveltimes replaced by the (less stringent and less subjective) requirement of having to define time windows around main reflections (or composite reflections) of interest. It is based on an errornorm, related to the phase of the wavefield, which is directly computed from wavefield measurements. Therefore, the cumbersome step of interpreting arrivals and measuring arrival times is avoided. The method is applied to the reconstruction of a depth dependent global velocity model from a set of line wave responses and is compared to other methods. Despite the fact that the new errornorm only makes use of data having a temporal bandwidth of a few Hz, its behavior is very similar to the behavior of the errornorm used in traveltime inversion. ESA

N92-14734# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

POSITIVE SOLUTIONS OF SEMILINEAR ELLIPTIC SYSTEMS

P. Clement, D. G. deFigueiredo, and E. Mitidieri (Udine Univ., Italy) 1991 25 p

(Rept-91-16; ISSN-0922-5641; ETN-92-90396) Copyright Avail: NTIS HC/MF A03

The existence of positive solutions for a given nonlinear elliptic system is investigated. The solutions are of a Dirichlet problem for the system in a bounded convex domain with smooth boundary. ESA

N92-14735# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

ON DEFINING CLASSES OF QUADRATIC SYSTEMS IN THE PLANE

J. W. Reyn 1991 40 p

(Rept-91-32; ISSN-0922-5641; ETN-92-90411) Copyright Avail: NTIS HC/MF A03

The definition of classes of quadratic systems in the plane is studied. Taking into account their index and multiplicity, possible combinations of singular points, both in the finite part of the plane and at infinity, lead to the definition of 173 classes of quadratic systems of differential equations in the plane. ESA

N92-14736# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

SECOND ORDER WAVE FORCES AND WAVE DRIFT DAMPING

A. J. Hermans 1991 19 p
(Rept-91-34; ISSN-0922-5641; ETN-92-90412) Copyright Avail: NTIS HC/MF A03

A formulation for the second order wave drift force on an object sailing at low forward speed is derived. The method used consists of the application of the law of conservation of impulse over the fluid domain outside the body. The large second order resonant motions where the damping coefficients in the equation of motion are mainly determined by the influence of motion on the mean drift force at the frequency of excitation are addressed. The results are compared with results obtained by the direct pressure integration method. Due to the small first order damping at small frequencies the second order wave drift damping becomes significant. A formulation for this coefficient based on the speed dependency of the wave drift force is presented. ESA

N92-14737# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON THE ZEROS OF ORTHOGONAL POLYNOMIALS IN A DISCRETE SOBOLEV SPACE WITH A SYMMETRIC INNER PRODUCT
H. Bavinck and H. G. Meijer 1991 21 p
(Rept-91-35; ISSN-0922-5641; ETN-92-90413) Copyright Avail: NTIS HC/MF A03

A continuation of a study on orthogonal polynomials in a discrete Sobolev space is presented. Orthogonal polynomials with respect to a given inner product which is symmetric with respect to the origin were computed and some properties concerning the zeros of these polynomials were given. In this study, the weight function is replaced by a more general non-negative symmetric weight function. Sets of both even and odd orthogonal polynomials are considered. ESA

N92-14738# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
ON THE METAMATHEMATICS OF WEAK THEORIES
Alessandro Berarducci (Aquila Univ., Italy) and Rineke Verbrugge Jan. 1991 22 p
(ITLI-ML-91-02; ISSN-0924-2090; ETN-92-90427) Avail: NTIS HC/MF A03

The metamathematics of the theory Iota(delta sub 0) + Omega(sub 1), which has emerged as one of the weakest theories adequate for arithmetizing syntax and for which the derivability conditions needed to prove Goedl's incompleteness theorems can be proved, is addressed. A modified Solovay construction is given. The conditions, the upper and lower bounds on PL(Omega) and the bifurcation depth using Montagna's disjunction property are proved. Some support to the conjecture that PL(Omega) is equal to L, provided that PL(Omega) is equal to the theory of some class of frames is concluded. A necessary and sufficient condition for PL(Omega) to be equal to L is shown. ESA

N92-14739# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
ON THE PROOFS OF ARITHMETICAL COMPLETENESS FOR INTERPRETABILITY LOGIC
Domenico Zambella Feb. 1991 13 p
(ITLI-ML-91-03; ISSN-0924-2090; ETN-92-90428) Avail: NTIS HC/MF A03

A study aimed at providing simple and natural proofs of arithmetical completeness for the binary modal logic IL (Interpretability Logic) extensions ILM (IL with Montagna's axiom) and ILP (IL with a Persistent relation in its models) is presented. Original Veltman models are used for both and the proofs are based on work by Sobolev and de Jongh, Jumelet and Montagna. The axioms of ILM and ILP and the corresponding classes of Veltman frames are recalled. No details are given but references to details and comments and proofs of the soundness of the axioms are provided. A general technique to obtain arithmetical completeness for theories containing IL, provided that modal completeness with respect to a certain class of finite frames exists, is presented. ESA

N92-14740# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
COLLAPSING GRAPH MODELS BY PREORDERS
Raymond Hoofman (Utrecht State Univ., Netherlands) and Harold Schellinx Mar. 1991 28 p
(ITLI-ML-91-04; ISSN-0924-2090; ETN-92-90429) Avail: NTIS HC/MF A03

A strategy for obtaining extensional (partial) combinatory algebras by slightly modifying the well known construction of graph models for the untyped lambda calculus is presented. Using the notions of semi functor and semi adjunction, an elegant interpretation of the construction on a category theoretical setting is given. ESA

N92-14741# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
IDEMPOTENTS
C. P. Schut Feb. 1991 8 p
(CWI-AM-R9101; ETN-92-90463) Copyright Avail: NTIS HC/MF A02

Some well known properties of natural number indempotents are summarized. The indempotents modulo 10 to the power k, where k is greater than or equal to 1, are classified using elementary calculations. Some regularities which occur in certain sequences of indempotents are explained. ESA

N92-14742# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
RICCATI AND SOLITON EQUATIONS
Michiel Hazewinkel Mar. 1991 13 p
(CWI-AM-R9103; ETN-92-90465) Copyright Avail: NTIS HC/MF A03

A number of integrable systems can be viewed as rational quotients of linear dynamical systems. This holds for the Korteweg-Devries equation, the Toda lattices and the KP equations. In particular it is pointed out that the KP equation is in fact an infinite dimensional Riccati equation. Conjecturally all integrable systems are rational quotients of linear ones. ESA

N92-14743# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
CONVERGENCE, CONTINUITY AND ITERATION IN MATHEMATICAL MORPHOLOGY
H. J. A. M. Heijmans and J. Serra (Ecole des Mines, Paris, France) Jan. 1991 35 p
(CWI-BS-R9104; ETN-92-90468) Copyright Avail: NTIS HC/MF A03

Continuity properties of morphological operators, or more generally, operators mapping a complete lattice into itself, are examined. For any sequence of lattice elements, its lim sup and lim inf can be defined and, in case both elements coincide, the sequence is said to converge. Using the notion of convergence, up and down continuity of lattice operators can be defined. For the case where the lattice is the family of all subsets of the discrete space Z sup d, explicit expressions for the lim sup and lim inf are easily found and criteria for the continuity of an operator are given. Special attention is given to well known morphological operators such as dilations, erosions, closings, openings, and hit or miss operators. Order continuity properties of a morphological operator play a major role in settling the problem when iteration of such an operator yields an indempotent one, e.g., an opening or a closing, and other strong filters, such as the middle element. An application to numerical functions is given. ESA

N92-14744# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
INDUCED CIRCUITS IN PLANAR GRAPHS
C. McDiarmid, B. Reed (Waterloo Univ., Ontario), A. Schrijver,

and B. Shepherd Feb. 1991 9 p
(CWI-BS-R9106; ETN-92-90469) Copyright Avail: NTIS HC/MF A02

A polynomial time algorithm for the problem of finding an induced circuit traversing two given vertices of a planar graph is given. A combinatorial algorithm and a min-max relation for the problem of finding a maximum number of paths connecting two given vertices in a planar graph so that each pair of these paths from an induced circuit are given. ESA

N92-14745# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
SOME DOMINATION PROBLEMS ON TREES AND ON GENERAL GRAPHS
Erwin M. Bakker and Jan vanLeeuwen Jun. 1991 26 p
(Contract EEC-3075)
(RUU-CS-91-22; ISSN-0924-3275; ETN-92-90486) Avail: NTIS HC/MF A03

Several variants of domination problems are studied. Linear time algorithms are given for path domination, independent efficient domination, and efficient total domination on trees. On the other hand, it is proven that these problems are NP complete for general graphs. All domination problems studied are derived from considerations about distributed data structuring and resource allocation in communication networks. ESA

N92-14746# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
PLANAR GRAPH AUGMENTATION PROBLEMS
Goos Kant and Hans L. Bodlaender Jul. 1991 33 p
(Contract EEC-3075)
(RUU-CS-91-25; ISSN-0924-3275; ETN-92-90489) Avail: NTIS HC/MF A03

The problem of adding a minimum number of edges to a planar graph in such a way that the resulting graph is biconnected and still planar is investigated. This problem is shown to be NP complete. Two approximation algorithms for this planar biconnectivity augmentation problem, running in O(n log n) time and O((n squared) log n) time, and that has performance ratio 2 and 3/2, respectively are presented. An O(n cubed) approximation algorithm with performance ratio 5/4 is presented to make a biconnected planar graph triconnected by adding edges without losing planarity. ESA

N92-14747# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
MINIMUM-LINK c-ORIENTED PATH QUERIES
John Adegeest, Mark Overmars, and Jack Snoeyink Jul. 1991 15 p Sponsored in part by EEC, and Netherlands Organization for Scientific Research
(RUU-CS-91-27; ISSN-0924-3275; ETN-92-90491) Avail: NTIS HC/MF A03

Paths composed of a minimum number of line segments parallel to a fixed set of c orientations that avoid a set of obstacles in the plane, are considered. The preprocessing of n line segment obstacles with disjoint interiors and a starting point A into a data structure using O(cn) space is carried out. With this data structure, the minimum number of line segments l of a path from A to a query point B in O(c log n) time is determined and a path in additional O(l) time is constructed. Preprocessing takes O((c squared)nlogn) time and space or O((c squared)n(log squared)n) time and O((c squared)n)) space. Usually c is a constant; for example, c = 2 for rectilinear paths. ESA

N92-14748# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
STATE SPACE FORMULAS FOR TRANSFER POLES AT INFINITY
M. Kuijper and J. M. Schumacher (Tilburg Univ., Netherlands) Mar. 1991 26 p Submitted for publication
(CWI-BS-R9108; ETN-92-90539) Avail: NTIS HC/MF A03

Formulas for the transfer pole/zero structure at infinity of linear time invariant systems are given in terms of subspaces of the input and output spaces. A characterization of the existence of a transfer function as well as its left/right invertibility is given by using the same subspaces. For systems that are represented in descriptor form the formulas are given in terms of the matrices E, A, B, C and D. No specific assumptions are made on the descriptor representation; in particular, the matrices E and A may be nonsquare. As easy corollaries, known formulas are recovered for the zeros at infinity of standard state space representations and for the infinite elementary divisors of matrix pencils sE - A. A geometric proof is given of the fact that the transfer zeros at infinity of descriptor representations that are controllable and observable at infinity coincide with the invariant zeros at infinity, as defined from the system pencil, whereas the transfer poles at infinity can be calculated as the zeros at infinity of sE - A. Again, the invertibility of sE - A is not required. ESA

N92-13946*# Cincinnati Univ., OH. Dept. of Mathematical Sciences.
COMPARISON OF FOUR STABLE NUMERICAL METHODS FOR ABEL'S INTEGRAL EQUATION
Diego A. Murio and Carlos E. Mejia *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 239-252 (For primary document see N92-13928 05-01)
Avail: NTIS HC/MF A99 CSCL 12A

N92-14085*# McDonnell-Douglas Space Systems Co., Houston, TX. Engineering Services Div.
ELIMINATION OF SECULAR TERMS FROM THE DIFFERENTIAL EQUATIONS FOR THE ELEMENTS OF PERTURBED TWO-BODY MOTION
Victor R. Bond and Michael F. Fraietta *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 265-283 (For primary document see N92-14070 05-13)
(Contract NAS9-17885)
Avail: NTIS HC/MF A21 CSCL 12A

N92-14094*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
CORRELATION TECHNIQUES TO DETERMINE MODEL FORM IN ROBUST NONLINEAR SYSTEM REALIZATION/IDENTIFICATION
Greselda I. Stry and D. Joseph Mook *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 443-459 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-14749# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
STOCHASTICITY IN THE SPECTRUM OF SOME HAMILTONIANS WITH DISCRETE SYMMETRY
Yu. L. Bolotin, V. Yu. Gonchar, and V. N. Tarasov (Academy of Sciences of the Ukrainian SSR, Kharkov.) 1989 26 p In RUSSIAN; ENGLISH summary
(DE91-628033; JINR-R-4-89-590) Avail: NTIS HC/MF A03

A new quantization of C sub 3v-invariant classical Hamiltonian using Birghoff-Gustavson's normal form is proposed. The introduction of the polar coordinates in the phase space simplifies the normal form and its quantal analogue. A simple quasiclassical analytic formula for the spectrum of collective quadrupole excitations of nuclei is obtained. This formula fits well to the exact level spacing in the energy region where the regular classical motion is prevailing. A C sub 4v-symmetric classical and quantum Hamiltonians are studied too. The presence of chaotic motion in

the case of potential function with a negative Gaussian curvature and the regularity of motion for the remaining cases is demonstrated. The critical energy for transition to chaos coincides with that obtained via Poincare sections and other methods. The role of the C sub 4v symmetry in the statistical distributions of the energy levels is discussed and the universality of the spectrum fluctuation laws is reestablished. DOE

N92-14750# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

A CONTINUOUS POLLING SYSTEM WITH GENERAL SERVICE TIMES

D. P. Kroese and V. Schmidt (Freiberg Mining Academy, German D.R.) Feb. 1991 29 p Sponsored by Netherlands Organization for Applied Scientific Research TNO

(MEMO-971; ISSN-0169-2690; ETN-92-90503) Avail: NTIS HC/MF A03

Consider a ring on which a server travels at constant speed. Customers arrive on the ring according to a Poisson process, at locations independently and uniformly distributed over the circle. Whenever the server encounters a customer, he stops and serves the client according to a general service time distribution. After the service is completed, the server removes the customer from the circle and resumes his round. The model is analyzed by means of point processes and regenerative processes in combination with some stochastic integration theory. This approach clarifies the analysis of the continuous polling model and provides the means for further generalizations. For every time, t, the locations of customers that are waiting for service and the positions of clients that have been served during the last tour of the server, are represented by random counting measures. These measures converge in distribution as t tends towards infinity. A recursive expression for the Laplace functionals of the limiting random measures is found, from which the corresponding kth moment measures can be derived. ESA

N92-14751# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

THE BATCH-ARRIVAL BULK-SERVICE QUEUE WITH POISSON ARRIVALS

J. C. W. vanOmmeren Jun. 1991 21 p

(MEMO-972; ISSN-0169-2690; ETN-92-90504) Avail: NTIS HC/MF A03

A queueing system where batches of customers arrive according to a Poisson process is considered. The server can handle a group of customers simultaneously. The waiting time distribution of an arbitrary customer in steady state is focused on. In particular, an asymptotic expansion of the waiting time distribution in the case that the Probability Mass Function (PMF) of the service group size has rational generating function is given. For the case that the service time distribution has a rational Laplace-Stieltjes tranform and the PMF of the arrival batch size has a rational generating function, the waiting time distribution and its Laplace-Stieltjes transform are derived. ESA

N92-14752# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

EQUIVALENCE OF NONLINEAR SYSTEMS TO INPUT-OUTPUT PRIME FORMS

R. Marino, W. Respondek (Polish Academy of Sciences, Warsaw.), and A. J. vanderSchaft Jun. 1991 30 p

(MEMO-975; ISSN-0169-2690; ETN-92-90507) Avail: NTIS HC/MF A03

The problem of transforming nonlinear control systems into input-output prime forms is dealt with, using state space, static state feedback, and also output space transformations. Necessary and sufficient geometric conditions for the solvability of this problem are obtained. The results obtained generalize well known results both on feedback linearization as well as on input-output decoupling of nonlinear systems. It turns out that from a computational point of view the output space transformation is the crucial step, which is performed by constructing rectifying coordinates for a nested sequence of distributions on the output manifold. ESA

N92-14753# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

A FRAMEWORK FOR TEST SELECTION

Ed Brinksma, Jan Tretmans, and Louis Verhaard Jun. 1991 19 p Sponsored in part by Commission of the European Communities

(Memo-INF-91-54; TIOS-91/022; ISSN-0923-1714; ETN-92-90514) Avail: NTIS HC/MF A03

A framework for test selection is proposed that works from the principle that in the practice test, suites are composed by selecting test cases on the basis of external knowledge, such as experience and heuristics, that cannot be reflected in the formal specification of the implementation being tested. It is proposed to model this knowledge in the abstract form of valuations, i.e., functions that assign weights to test suites according to their relative importance. The properties valuations should have to obtain a satisfactory model, and how valuations can be defined and obtained in practice, are analyzed. For this purpose, the concept of test purpose (and its negation test failure) are formalized as predicates over the class of all specifications/behaviors. Ultimately, this leads to the formulation of test selection as an optimization problem over Boolean algebras. The usefulness of the framework is illustrated by way of an elaborated example. The conclusion contains some speculations about possible further extensions of the approach followed. ESA

N92-14754# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.

COMBINATORIAL PROPERTIES OF FINITE SEQUENCES WITH HIGH KOLOMOGOROV COMPLEXITY

Ming Li (Waterloo Univ., Ontario) and Paul M. B. Vitanyi 29 Jun. 1991 17 p Sponsored in part by Canadian Natural Sciences and Engineering Research Council International Scientific Exchange Award

(Grants NSERC-OGP-0036747; NSERC-OGP-046506)

(ITLI-CT-91-09; ISSN-0924-8374; ETN-92-90524) Avail: NTIS HC/MF A03

The extent to which finite binary sequences with high Kolmogorov complexity are normal (all blocks of equal length occur equally frequent) is discussed. Additionally, the maximal length of all zero or all none runs which occur with certainty is investigated. ESA

N92-14755# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.

APPROXIMATE PERFORMABILITY ANALYSIS USING GENERALIZED STOCHASTIC PETRI NETS

Boudewijn R. Haverkort May 1991 18 p

(Memo-INF-91-40; TIOS-91/013; ISSN-0923-1714; ETN-92-90356) Avail: NTIS HC/MF A03

The problem of calculating performability measures from performability models of fault tolerant computer systems is addressed. Since these systems tend to be large and complex, the corresponding performability models will in general also be large and complex. To alleviate the largeness problem to some extent, Generalized Stochastic Petri Nets (GSPN's) are used to describe the models. Still however, many models can not be solved with the current numerical techniques, although they are conveniently and often compactly described. Two heuristic state space truncation techniques that allow very good approximations to be obtained while only accessing a few percent of the overall state space are discussed. Examples of the usage and theoretical evidence in the correctness of the employed truncation techniques are given. GSPN's are shown to be very suitable for implementing (describing) the proposed truncation techniques. ESA

N92-14756# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

POST'S SYSTEM OF TAG: A SIMPLE DISCRETE NONLINEAR SYSTEM

Peter R. J. Asveld Jun. 1991 9 p

(Memo-INF-91-44; ISSN-0923-1714; ETN-92-90359) Avail: NTIS HC/MF A02

We consider an instance, T sub 0, of Post's system of tag and show that it is nonlinear. Some computer simulations are discussed and the periodic behavior of T sub 0 is studied. ESA

N92-14757# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
THE GRENANDER ESTIMATOR OF A MONOTONE DENSITY: BASIC FACTS
Piet Groeneboom and Hendrik P. Lopuhaae 1991 12 p
(Rept-91-01; ISSN-0922-5641; ETN-92-90381) Copyright Avail: NTIS HC/MF A03

Short proofs of two basic results from a nonparametric density estimation are given. A straightforward argument is given to show that the left continous version of the concave majorant of the empirical distribution function maximizes the likelihood function within the class of nonincreasing densities. Furthermore, a short proof to show that the number of vertices of the concave majorant of the uniform empirical distribution function is asymptotically normal with asymptotic mean and variance both equal to log n is given. ESA

N92-14758# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
SCALE SENSITIVITY AND RANK PRESERVATION IN A MULTIPLICATIVE VARIANT OF THE ANALYTIC HIERARCHY PROCESS
F. A. Lootsma 1991 33 p
(Rept-91-20; ISSN-0922-5641; ETN-92-90400) Copyright Avail: NTIS HC/MF A03

The reputation of Saaty's Analytic Hierarchy Process would not be diminished by the replacement of obsolete details such as the fundamental scale to quantify human judgement, the Perron-Frobenius eigenvector to estimate the impact scores, and the arithmetic mean aggregation rule to calculate the final scores of the decision alternatives. Because the fundamental scale introduces inconsistencies which are not present in the mind of the decison maker, the study replaces it by a number of geometric scales which are based on psychophysical arguments. These scales are only used at the first evaluation level, when the alternatives under each of the criteria separately are compared. The impact scores are estimated by logarithmic regression because it frequently happens that the pairwise comparisons are incomplete (missing data). The rank order of the impact scores appears to be invariant when geometric scales are employed. The delicate aggregation step is improved by the geometric mean aggregation rule and by a new definition of the relative importance of the criteria. The geometric mean aggregation rule has the property of infinite compensation for zero preference, so that it is usually more plausible than the arithmetic mean rule with finite compensation of zero preference. Moreover, it is demonstrated that at the second evaluation level there is only one geometric scale to quantify the relative importance of the criteria. The rank order of the final scores of the alternatives does therefore not depend on the geometric scale employed to calculate the impact scores at the first level. ESA

N92-14759# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
ASYMPTOTIC INVERSION OF INCOMPLETE GAMMA FUNCTIONS
N. M. Temme Feb. 1991 18 p
(CWI-AM-R9102; ETN-92-90464) Copyright Avail: NTIS HC/MF A03

The normalized incomplete gamma functions P(a,x) and Q(a,x) are inverted for large values of the parameter a. This is, x solutions of the equations P(a,x) = p, Q(a,x) = q, p belongs to the closed interval (0,1), q = 1 - p, are considered, especially for large values of a. The approximations are obtained by using uniform asymptotic expansions of the incomplete gamma functions, in which an error function is the dominant term. The inversion problem is started by inverting this error function term. Numerical results indicate that for obtaining an accuracy of four correct digits the method can already be used for a = 2, although a is a large parameter. It is indicated that the method can be applied to other cumulative distribution functions. ESA

N92-14760# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Analysis, Algebra and Geometry.
RANDOM ADDITIVE FUNCTIONALS WITH RAPID MARKOV SWITCHINGS
V. V. Korolyuk (Kiev Univ., USSR) Apr. 1991 18 p
(CWI-AM-R9104; ETN-92-90466) Copyright Avail: NTIS HC/MF A03

The martingale approach is applied to the asymptotical analysis of random additive functionals with rapid Markov switchings. Two essentially different situations are considered by that: under a ergodicity of an irreducible switching Markov processes, and in the scheme of asymptotic phase merging when the switching process depends on a small series parameter in such a way that the supporting process is reducible. ESA

N92-14761# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
OPTIMAL CHOICE OF SAMPLE FRACTION IN EXTREME-VALUE ESTIMATION
Arnold L. M. Dekkers and Laurens deHaan (Erasmus Univ., Rotterdam, Netherlands) Mar. 1991 21 p
(CWI-BS-R9107; ETN-92-90470) Copyright Avail: NTIS HC/MF A03

The asymptotic bias of the moment estimator gamma(sub n) for the extreme value index gamma belongs to R (set of Real numbers) under quite natural and general conditions on the underlying distribution function is studied. Furthermore, the optimal choice for the sample fraction in estimating gamma is considered by minimizing the mean squared error of gamma(sub n) - gamma. The results cover all three limiting types of extreme value theory. The connection between statistics and regular variation and ll-variation is handled in a systematic way. ESA

N92-14762# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE OPTIMAL PLACEMENT OF REPLICATED ITEMS IN DISTRIBUTED DATABASES ON TREE-LIKE NETWORKS
Erwin M. Bakker and Jan vanLeeuwen Jun. 1991 9 p
(Contract EEC-3075)
(RUU-CS-91-23; ISSN-0924-3275; ETN-92-90487) Avail: NTIS HC/MF A02

An issue concerning the optimal placement of replicated items in distributed databases is studied. A reasonable cost function was previously proposed that models the tradeoff between the retrieval and update costs of replicated data and their location in a communication network. For networks that have a tree structure, we present a linear time data allocation scheme that minimizes this cost function. ESA

N92-14763# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
RECOGNITION OF OVERLAPPING OBJECTS USING MARKOV SPATIAL PROCESSES
A. J. Baddeley and M. N. M. vanLieshout (Vrije Univ., Amsterdam, Netherlands) Mar. 1991 38 p Submitted for publication
(CWI-BS-R9109; ETN-92-90540) Copyright Avail: NTIS HC/MF A03

The Bayesian approach to image processing based on Markov random fields is adapted to image analysis problems such as object recognition and edge detection. Here the input is a gray scale or binary image and the desired output is a graphical pattern in continuous space, such as a list of geometric objects or a line drawing. The natural prior models are Markov point processes and random patterns from stochastic geometry and spatial statistics. Analogs of Besag's ICM algorithm and the Geman-Geman simulated annealing algorithm are developed and relationships with

existing techniques like the Hough transform and the erosion operator in mathematical morphology are presented. The methods are demonstrated on a simple example. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-14764# Strategic Defense Initiative Organization, Washington, DC.
ZEST FLIGHT TEST EXPERIMENTS, KAUAI TEST FACILITY, HAWAII
Martha J. Cenkci Jul. 1991 143 p
(AD-A241143) Avail: NTIS HC/MF A07 CSCL 15/6

The Strategic Defense Initiative Organization (SDIO) is proposing to execute two ZEST flight experiments to obtain information related to the following objectives: validation of payload modeling; characterization of a high energy release cloud; and documentation of scientific phenomena that may occur as a result of releasing a high energy cloud. The proposed action is to design, develop, launch, and detonate two payloads carrying high energy explosives. Activities required to support this proposal include: (1) execution of component assembly tests at Space Data Division (SDD) in Chandler, Arizona and Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico, and (2) execution of pre-flight flight test activities at Kauai Test Facility. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-14765# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
THE ALGEBRA OF KILLING VECTORS IN FIVE-DIMENSIONAL SPACE
G. L. Rcheulishvili 1990 16 p
(DE91-635976; IHEP-OTF-90-107; IFVE-OTF-90-107) Avail: NTIS HC/MF A03

This paper presents algebras which are formed by the found earlier Killing vectors in the space with linear element ds. Under some conditions, an explicit dependence of r is given for the functions entering in linear element ds. The curvature two-forms are described. DOE

N92-14766# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
ON THE SUM OF TWO MAXIMAL MONOTONE OPERATORS, 2
Paul Egberts 1991 14 p
(Rept-91-31; ISSN-0922-5641; ETN-92-90410) Copyright Avail: NTIS HC/MF A03

Types of inclusions in Hilbert space, where the operators are maximal monotone (or equivalently m-accretive), are considered. A theorem for the existence of a symmetric m-accretive operator is given. ESA

N92-14767# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
LINDELOEF IN VERSUS IN LINDELOEF
A. Dow (York Univ., Ontario) and J. Vermeer 1991 8 p Sponsored in part by Natural Sciences and Engineering Research Council
(Rept-91-23; ISSN-0922-5641; ETN-92-90424) Avail: NTIS HC/MF A02

A space X is said to be Lindelhof in a space Z if every open cover of Z has a countable subcover of X. The question of Arhangelskii as to whether there must always be a Lindelhof Y with X contained in Y contained in Z is answered in the negative. P spaces are introduced since the question seems to be much easier to analyze when X is a P space. An interesting question about the existence of ccc P sets in the remainder of P spaces is also uncovered. ESA

N92-14768# Amsterdam Univ. (Netherlands). Inst. for Language, Logic and Information.
THE CONSISTENCY OF AN EXTENDED NADSET
Paul C. Gilmore (British Columbia Univ., Vancouver.) 5 Dec. 1990 39 p
(ITLI-ML-90-11; ISSN-0924-2090; ETN-92-90425) Avail: NTIS HC/MF A03

A Natural Deduction based logic and Set theory called NaDSet is presented. The elementary syntax and the logical syntax, or proof theory, for NaDSet is described. Some definitions and results of a combinatorial nature are provided which depend largely on the elementary syntax. The same is done for definitions and results depending upon the logical syntax. The consistency of elementary number theory: namely, a transfinite induction argument over the ordinals less than epsilon sub 0 demonstrates that the empty sequent has no derivation in NaDSet. ESA

N92-14769# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
POINT LOCATION IN ZONES OF k-FLATS IN ARRANGEMENTS
Mark deBerg, Marc vanKreveld, and Jack Snoeyink Apr. 1991 14 p Sponsored in part by EEC, and Netherlands Organization for Scientific Research
(RUU-CS-91-9; ISSN-0924-3275; ETN-92-90473) Avail: NTIS HC/MF A03

Let A(H) be the arrangemment of a set H of n hyperplanes in d space. A k flat is defined to be a k dimensional affine subspace of d space. The zone of k flat f with respect to H is the closure of all cells in A(H) that intersect f. Some problems in zones of k flats are studied. The most important result is a data structure for point location in the zone of k flat. This structure uses O(n exp((d/2) + epsilon) + n exp(k + epsilon)) preprocessing time and space and has a query time of O(log(exp 2)n). It is also shown whether two flats are visible for each other with respect to a set of hyperplanes. ESA

N92-14770# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research, Statistics, and System Theory.
ZERO DRIFT RANDOM WALK ON N BY N WITH REFLECTION, ERGODICITY CONDITIONS
J. W. Cohen Jun. 1991 7 p
(CWI-BS-R9114; ETN-92-90545) Copyright Avail: NTIS HC/MF A02

A continuation of a previous study on the two dimensional random walk, its hitting process and its classification, is presented. The study concerns the explicit formulation of the conditions for the random walk to be positive, null or nonrecurrent in terms of the first and second moments of the various one step displacement vectors. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-14771*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CENTER FOR SPACE MICROELECTRONICS TECHNOLOGY Technical Report, 1990
15 Jul. 1991 95 p
(Contract NAS7-918)
(NASA-CR-189451; JPL-Publ-91-18; NAS 1.26:189451) Avail: NTIS HC/MF A05 CSCL 20C

The 1990 technical report of the Jet Propulsion Laboratory Center for Space Microelectronics Technology summarizes the

technical accomplishments, publications, presentations, and patents of the center during 1990. The report lists 130 publications, 226 presentations, and 87 new technology reports and patents. For individual titles, see N92-14772 through N92-14775.

N92-14772*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLID STATE DEVICES **c76**
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 7-33 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 20L

The Solid State Device research program is directed toward developing innovative devices for space remote and in-situ sensing, and for data processing. Innovative devices can result from the standard structures in innovative materials such as low and high temperature superconductors, strained layer superlattices, or diamond films. Innovative devices can also result from innovative structures achieved using electron tunneling or nanolithography in standard materials. A final step is to use both innovative structures and innovative materials. A new area of emphasis is the miniaturization of sensors and instruments molded by using the techniques of electronic device fabrication to micromachine silicon into micromechanical and electromechanical sensors and actuators. Author

N92-14773*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTONICS **c74**
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 37-53 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 20F

Optoelectronic materials and devices are examined. Optoelectronic devices, which generate, detect, modulate, or switch electromagnetic radiation are being developed for a variety of space applications. The program includes spatial light modulators, solid state lasers, optoelectronic integrated circuits, nonlinear optical materials and devices, fiber optics, and optical networking photovoltaic technology and optical processing. Author

N92-14774*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADVANCED COMPUTING **c61**
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 57-79 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 09B

Advanced concepts in hardware, software and algorithms are being pursued for application in next generation space computers and for ground based analysis of space data. The research program focuses on massively parallel computation and neural networks, as well as optical processing and optical networking which are discussed under photonics. Also included are theoretical programs in neural and nonlinear science, and device development for magnetic and ferroelectric memories. Author

N92-14775*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CUSTOM MICROCIRCUITS **c33**
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 83-87 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 09C

The goals of this program are to develop custom microcircuit technology, also known as Application Specific Integrated Circuit (ASIC) technology, for use in flight and ground programs. Supporting this effort are activities to investigate the effects of the space environment, and particularly ionizing radiation, on microcircuits and to develop a space qualification methodology. Another aspect of the program emphasizes innovative applications of custom microcircuit technology to image and signal processing and communications. Author

N92-14776# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: PHYSICS AND MATHEMATICS
3 Dec. 1991 44 p Transl. into ENGLISH of various Russian articles
(JPRS-UPM-91-007) Avail: NTIS HC/MF A03

Abstracts of Soviet publications in various areas of physics and mathematics are presented. The areas covered include: acoustics, lasers, nuclear physics, optics, spectroscopy, superconductivity, plasma physics, and thermodynamics. K.S.

N92-14777# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: PHYSICS AND MATHEMATICS
16 Sep. 1991 43 p Transl. into ENGLISH of various Russian articles
(JPRS-UPM-91-006) Avail: NTIS HC/MF A03

Abstracts of Soviet publications in various areas of physics and mathematics are presented. The areas covered include: lasers, nuclear physics, optics, spectroscopy, plasma physics, and superconductivity. K.S.

N92-14778# California Univ., Berkeley. Lawrence Berkeley Lab.
MAGNETIC FIELD IN THE END REGION OF THE SSC QUADRUPOLE MAGNET
S. Caspi, M. Helm, and L. J. Laslett Jun. 1991 5 p Presented at the 12th International Conference on Magnet Technology, Leningrad (USSR), 23-28 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000850; LBL-29819; SC-MAG-316; CONF-910662-3)
Avail: NTIS HC/MF A01

Recent advances in methods of computing magnetic fields have made it possible to study the field in the end region of the SSC quadrupole magnet in detail. The placement of a conductor in the straight section, away from the ends, was designed to produce a practically pure quadrupole field in the two-dimensional sense. The ends of the coils were designed to produce a practically pure quadrupole field in the integral sense, using a method that ignores the presence of the iron yoke. Subsequently, the effect of presence of the yoke on the field was analyzed. The paper presents the end configuration together with the computed integrated multipole components, local multipole components, and local field components. A comparison with measurements is included. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-14779*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AEROACOUSTICS OF FLIGHT VEHICLES: THEORY AND PRACTICE. VOLUME 2: NOISE CONTROL
Harvey H. Hubbard, ed. Washington Aug. 1991 443 p Sponsored in cooperation with the Army Aviation Systems Command
(Contract F33615-84-C-3202)
(NASA-RP-1258-Vol-2; L-16926-Vol-2; NAS 1.61:1258-Vol-2; WRDC-TR-90-3052-Vol-2) Avail: NTIS HC/MF A19 CSCL 20A

Flight vehicles and the underlying concepts of noise generation, noise propagation, noise prediction, and noise control are studied. This volume includes those chapters that relate to flight vehicle noise control and operations: human response to aircraft noise; atmospheric propagation; theoretical models for duct acoustic propagation and radiation; design and performance of duct acoustic treatment; jet noise suppression; interior noise; flyover noise measurement and prediction; and quiet aircraft design and operational characteristics. For individual titles, see N92-14780 through N92-14787.

N92-14780*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HUMAN RESPONSE TO AIRCRAFT NOISE
Clemans A. Powell and James M. Fields (General Accounting Office, Washington, DC.) *In its* Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 1-52 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The human auditory system and the perception of sound are discussed. The major concentration is on the annnoyance response and methods for relating the physical characteristics of sound to those psychosociological attributes associated with human response. Results selected from the extensive laboratory and field research conducted on human response to aircraft noise over the past several decades are presented along with discussions of the methodology commonly used in conducting that research. Finally, some of the more common criteria, regulations, and recommended practices for the control or limitation of aircraft noise are examined in light of the research findings on human response. Author

N92-14781*# National Research Council of Canada, Ottawa (Ontario).
ATMOSPHERIC PROPAGATION
Tony F. W. Embleton and Gilles A. Daigle *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 53-99 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

Reviewed here is the current state of knowledge with respect to each basic mechanism of sound propagation in the atmosphere and how each mechanism changes the spectral or temporal characteristics of the sound received at a distance from the source. Some of the basic processes affecting sound wave propagation which are present in any situation are discussed. They are geometrical spreading, molecular absorption, and turbulent scattering. In geometrical spreading, sound levels decrease with increasing distance from the source; there is no frequency dependence. In molecular absorption, sound energy is converted into heat as the sound wave propagates through the air; there is a strong dependence on frequency. In turbulent scattering, local variations in wind velocity and temperature induce fluctuations in phase and amplitude of the sound waves as they propagate through an inhomogeneous medium; there is a moderate dependence on frequency. Author

N92-14782*# Missouri Univ., Rolla.
THEORETICAL MODELS FOR DUCT ACOUSTIC PROPAGATION AND RADIATION
Walter Eversman *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 101-163 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The development of computational methods in acoustics has led to the introduction of analysis and design procedures which model the turbofan inlet as a coupled system, simultaneously modeling propagation and radiation in the presence of realistic internal and external flows. Such models are generally large, require substantial computer speed and capacity, and can be expected to be used in the final design stages, with the simpler models being used in the early design iterations. Emphasis is given to practical modeling methods that have been applied to the acoustical design problem in turbofan engines. The mathematical model is established and the simplest case of propagation in a duct with hard walls is solved to introduce concepts and terminologies. An extensive overview is given of methods for the calculation of attenuation in uniform ducts with uniform flow and with shear flow. Subsequent sections deal with numerical techniques which provide an integrated representation of duct propagation and near- and far-field radiation for realistic geometries and flight conditions. Author

N92-14783*# General Electric Co., Cincinnati, OH.
DESIGN AND PERFORMANCE OF DUCT ACOUSTIC TREATMENT
R. E. Motsinger and R. E. Kraft *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 165-206 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The procedure for designing acoustic treatment panels used to line the walls of aircraft engine ducts and for estimating the resulting suppression of turbofan engine duct noise is discussed. This procedure is intended to be used for estimating noise suppression of existing designs or for designing new acoustic treatment panels and duct configurations to achieve desired suppression levels. Author

N92-14784*# General Electric Co., Cincinnati, OH.
JET NOISE SUPPRESSION
P. R. Gliebe, J. F. Brausch, R. K. Majjigi, and R. Lee *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 207-269 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The objectives of this chapter are to review and summarize the jet noise suppression technology, to provide a physical and theoretical model to explain the measured jet noise suppression characteristics of different concepts, and to provide a set of guidelines for evolving jet noise suppression designs. The underlying principle for all jet noise suppression devices is to enhance rapid mixing (i.e., diffusion) of the jet plume by geometric and aerothermodynamic means. In the case of supersonic jets, the shock-cell broadband noise reduction is effectively accomplished by the elimination or mitigation of the shock-cell structure. So far, the diffusion concepts have predominantly concentrated on jet momentum and energy (kinetic and thermal) diffusion, in that order, and have yielded better noise reduction than the simple conical nozzles. A critical technology issue that needs resolution is the effect of flight on the noise suppression potential of mechanical suppressor nozzles. A more thorough investigation of this mechanism is necessary for the successful development and design of an acceptable noise suppression device for future high-speed civil transports. M.G.

N92-14785*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INTERIOR NOISE
John S. Mixson and John F. Wilby (Atlantic Applied Research Corp., Los Angeles, CA.) *In its* Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 271-355 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The generation and control of flight vehicle interior noise is discussed. Emphasis is placed on the mechanisms of transmission through airborne and structure-borne paths and the control of cabin noise by path modification. Techniques for identifying the relative contributions of the various source-path combinations are also discussed along with methods for the prediction of aircraft interior noise such as those based on the general modal theory and statistical energy analysis. M.G.

N92-14786*# Boeing Co., Seattle, WA. Noise Engineering Organization.
FLYOVER-NOISE MEASUREMENT AND PREDICTION
Noel A. Peart *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 357-382 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

Details are presented for the measurement and prediction of aircraft flyover noise to be used for certification, research and development, community noise surveys, airport monitors, and pass fail criteria. Test details presented are applicable to all types of aircraft, both large and small, and the use of Federal Aviation

Regulations (FAR) Part 36 (ref. 1) is emphasized. Accuracy of noise measurements is important. Thus, a pass-fail criterion should be used for all noise measurements. Finally, factors which influence the sound propagation and noise prediction procedures, such as atmospheric and ground effects, are also presented. Author

N92-14787*# Boeing Co., Seattle, WA.
QUIET AIRCRAFT DESIGN AND OPERATIONAL CHARACTERISTICS
Charles G. Hodge *In* NASA. Langley Research Center, Aeroacoustics of Flight Vehicles: Theory and Practice. Volume 2: Noise Control Aug. 1991 p 383-413 (For primary document see N92-14779 05-71)
Avail: NTIS HC/MF A19 CSCL 20A

The application of aircraft noise technology to the design and operation of aircraft is discussed. Areas of discussion include the setting of target airplane noise levels, operational considerations and their effect on noise, and the sequencing and timing of the design and development process. Primary emphasis is placed on commercial transport aircraft of the type operated by major airlines. Additionally, noise control engineering of other types of aircraft is briefly discussed. Author

N92-14788*# AeroChem Research Labs., Inc., Princeton, NJ.
DIRECT COMPUTATION OF TURBULENCE AND NOISE Final Report, 29 Mar. 1989 - 29 Jun. 1991
C. Berman, G. Gordon, G. Karniadakis, P. Batcho, E. Jackson, and S. Orszag (Vector Technology, Inc., Princeton, NJ.) Sep. 1991 77 p
(Contract NAS1-18849)
(NASA-CR-187616; NAS 1.26:187616; TP-499) Avail: NTIS HC/MF A05 CSCL 20A

Jet exhaust turbulence noise is computed using a time dependent solution of the three dimensional Navier-Stokes equations to supply the source terms for an acoustic computation based on the Phillips convected wave equation. An extrapolation procedure is then used to determine the far field noise spectrum in terms of the near field sound. This will lay the groundwork for studies of more complex flows typical of noise suppression nozzles. Author

N92-14789*# Florida Atlantic Univ., Boca Raton. Dept. of Ocean Engineering.
THE APPLICATION OF EXPERIMENTAL DATA TO BLADE WAKE INTERACTION NOISE PREDICTION
Stewart A. L. Glegg and William J. Devenport Oct. 1991 20 p Presented at the 6th International Symposium on Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines and Propellers, Notre Dame, IN, 15-19 Sep. 1991
(Grant NAG1-1119)
(NASA-CR-189461; NAS 1.26:189461) Avail: NTIS HC/MF A03 CSCL 20A

Blade wake interaction noise (BWI) has been defined as the broadband noise generated by the ingestion of turbulent trailing tip vortices by helicopter rotors. This has been shown to be the dominant contributor to the subjectively important part of the acoustic spectrum for the approach stage of a helicopter flyover. A prediction method for BWI noise based on the calculated trailing vortex trajectories has been developed and estimates of the vortex turbulence have been made. These measurements were made on a trailing vortex from a split wing arrangement and did not give the spectrum of the velocity fluctuations. A recent experiment carried out to measure the turbulence associated with a trailing vortex and the application of the results to BWI noise prediction is described. Author

N92-14790*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE PROPAGATION CHARACTERISTICS OF THE PLATE MODES OF ACOUSTIC EMISSION WAVES IN THIN ALUMINUM PLATES AND THIN GRAPHITE/EPOXY COMPOSITE PLATES AND TUBES Ph.D. Thesis - Johns Hopkins Univ., 1991
William H. Prosser Nov. 1991 178 p
(NASA-TM-104187; NAS 1.15:104187) Avail: NTIS HC/MF A09 CSCL 20A

Acoustic emission was interpreted as modes of vibration in plates. Classical plate theory was used to predict dispersion curves for the two fundamental modes and to calculate the shapes of flexural waveforms produced by vertical step function loading. There was good agreement between theoretical and experimental results for aluminum. Composite materials required the use of a higher order plate theory (Reissner-Mindlin) to get good agreement with the measured velocities. Four composite plates with different laminate stacking sequences were studied. The dispersion curves were determined from phase spectra of the time dependent waveforms. Plate modes were shown to be useful for determining the direction of source motion. Aluminum plates were loaded by breaking a pencil lead against their surface. By machining slots at angles to the plane of a plate, the direction in which the force acted was varied. Changing the source motion direction produced regular variations in the waveforms. To demonstrate applicability beyond simple plates, waveforms produced by lead breaks on a thin walled composite tube were also shown to be interpretable as plate modes. The tube design was based on the type of struts proposed for Space Station Freedom's trussed structures. Author

N92-14791# Institute for Water Resources, Fort Belvoir, VA.
REDUCING ENVIRONMENTAL NOISE IMPACTS: A USAREUR NOISE MANAGEMENT PROGRAM HANDBOOK Final Report
Timothy D. Feather and Ted K. Shekell Jun. 1991 167 p Prepared in cooperation with Planning and Management Consultants Ltd., Carbondale, IL
(AD-A240797; IWR-91-R-5) Avail: NTIS HC/MF A08 CSCL 20/1

Noise pollution is a major environmental problem faced by the U.S. Army in Europe. Noise-related complaints from German citizens can escalate into intense political issues in German communities. This in turn hampers efficient operation of military training and often times threatens the Army's mission. In order to remedy these problems, USAREUR has developed a noise management program. A successful noise management program will limit the impact of unavoidable noise on the populace. This report, a component of the noise management program, is a reference document for noise management planning. It contains guidelines and rules-of-thumb for noise management. This document contains procedures which operation and training level personnel can understand and apply in their day to day noise management planning. Noise mitigation tips are given. Basic technical information that will aid in understanding noise mitigation is provided along with noise management through land use planning. Noise management for specific components of the military community, (airfields, base operations, training areas, and housing and recreation areas) are addressed. The nature of noise generated, means of noise abatement at the source, path, and receiver (both physical and organizational/public relations methods), and a case study example are described. GRA

N92-14792# Army Construction Engineering Research Lab., Champaign, IL.
MODELING NONLINEAR ACOUSTICAL BLAST WAVES OUTDOORS: A RESEARCH SUMMARY Final Report
Victor W. Sparrow Sep. 1991 15 p
(AD-A241030; CERL-SR-N-91/24) Avail: NTIS HC/MF A03 CSCL 20/1

Current techniques for predicting sound propagation outdoors do not accurately model the physics of very loud sounds (over 150 dB), where the mathematics governing the sound propagation become nonlinear. As a result, Army installations need to measure and characterize impulse noises from actual blasts to anticipate environmental impacts of military operations on neighboring communities. This report summarizes research that developed and verified a numerical method to model nonlinear acoustical blast waves, and investigated the interaction between the finite amplitude blast waves and a natural ground surface. Absorbing boundary

conditions were also developed to allow for a numerical solution on a relatively small computational domain. It was determined that, as the finite amplitude effects are increased, the effect of a finite ground impedance is decreased. Since this relationship is itself nonlinear, this implies that the practice of simply adding finite amplitude effects and ground surface effects to find sound levels is not valid. Linear extrapolations and techniques should only be used where linear acoustics are applicable. GRA

N92-14793# Massachusetts Inst. of Tech., Cambridge.
PREDICTIONS AND OBSERVATIONS OF SEAFLOOR INFRASONIC NOISE GENERATED BY SEA SURFACE ORBITAL MOTION M.S. Thesis
Timothy E. Lindstrom Sep. 1991 106 p
(Contract N00123-89-G-0582)
(AD-A241316) Avail: NTIS HC/MF A06 CSCL 20/1

A model is developed for the prediction of the seismo-acoustic noise spectrum in the microseism peak region 0.1 to 0.7 Hz. The model uses a theory developed by Cato (1991) for an infinite depth ocean in which the surface orbital motion caused by gravity waves may produce acoustic waves at twice the gravity wave frequency. Using directional wave spectra as inputs, acoustic source levels are computed and incorporated into a more realistic environment consisting of a horizontally stratified ocean with an elastic bottom. Noise predictions are made using directional wave spectra obtained from the Surface Wave Dynamics Experiment (SWADE) surface buoys moored off the coast of Virginia and the SAFARI sound propagation code, with a bottom model derived using wave speeds measured in the EDGE deep seismic reflection survey. The predictions are analyzed for noise level variations with frequency, wave height, wind direction, and receiver depth. These predictions are compared to noise measurements made in ECONOMEX using near bottom receivers located close to the surface buoys. Good agreement is found between the predictions and observations under a variety of environmental conditions. GRA

N92-14794# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
OCEANOGRAPHIC AND TOPOGRAPHIC INTERACTIONS IN UNDERWATER ACOUSTIC PROPAGATION, WITH REGIONAL APPLICATIONS Ph.D. Thesis
Jessie Caton Carman May 1991 303 p
(Contract N00123-89-G-0575)
(AD-A241317) Avail: NTIS HC/MF A14 CSCL 20/1

Accurate range dependent underwater acoustic propagation using a parabolic approximation to the Helmholtz equation, and including sediment interactions, can be calculated in any part of the world ocean using sound speed fields generated by the Harvard Open Ocean Modeling system. The resulting acoustic predictions can be valid at any time for which oceanographic mesoscale environmental fields can be forecast. A thorough study is conducted of the effects of inclusion of a fluid sediment model with variable topographic depth on underwater acoustic propagation at low frequencies (25-100 Hz). Source depth and frequency dependencies of propagation patterns in the presence of such a sediment model are delineated in two realistic Gulf Stream region sound speed profiles. Effects of source depth and frequency on sensitivity to values of model parameters are determined and fundamental physical reasons for these sediment interaction effects given. Unusual propagation regimes occurring when source sound speed exceeds bottom sound speed, and then extreme sensitivity of these propagation regimes to sediment parametrization, are documented. Propagation effects are separately determined for topographic variations such as monotonic increase or decrease of depth, and oceanographic variations. Interaction effects when both physical conditions vary are detailed . Acoustic propagation is also studied in two other Atlantic regions. Distinct oceanographic surface boundary layer effects at frequencies too low for duct trapping are documented in the North Atlantic Drift Current region: the surface boundary layer prevents sound from deep sources from penetrating the shallow regions for certain frequency ranges. Strong dependence of propagation on source depth, frequency, topography, and oceanography is described in detail. GRA

N92-14795*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTATION OF SUPERSONIC JET MIXING NOISE FOR AN AXISYMMETRIC CD NOZZLE USING k-EPSILON TURBULENCE MODEL
Abbas Khavaran (Sverdrup Technology, Inc., Brook Park, OH.), Eugene A. Krejsa, and Chan M. Kim 1991 16 p Proposed for presentation at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(NASA-TM-105338; E-6705; NAS 1.15:105338; AIAA-92-0500)
Avail: NTIS HC/MF A03 CSCL 20A

The turbulent mixing noise of a supersonic jet is calculated for a round convergent-divergent nozzle at the design pressure ratio. Aerodynamic computations are performed using the PARC code with a k-epsilon turbulence model. Lighthill's acoustic analogy combined with Ribner's assumption is adopted. The acoustics solution is based upon the methodology followed by GE in the MGB code. The source correlation function is expressed as a linear combination of second-order tensors. Assuming separable second-order correlations and incorporating Batchelor's isotropic turbulence model, the source term was calculated from the kinetic energy of turbulence. A Gaussian distribution for the time-delay of correlation was introduced. The computational fluid dynamics (CFD) solution was used to obtain the source strength as well as the characteristic time-delay of correlation. The effect of sound/flow interaction was incorporated using the high frequency asymptotic solution to Lilley's equation for axisymmetric geometries. Acoustic results include sound pressure level directivity and spectra at different polar angles. The aerodynamic and acoustic results demonstrate favorable agreement with experimental data. Author

N92-14796# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
ACOUSTIC EMISSION
A. Straus, M. I. LopezPumarega, J. O. DiGaetano, C. E. DAtellis, and J. E. Ruzzante 1990 7 p Presented at the 18th Annual Meeting of the Argentine Association of Nuclear Technology (AANT), Buenos Aires, Argentina, 22-26 Oct. 1990
(DE91-642293; INIS-mf-12943; CONF-9010363) Avail: NTIS HC/MF A02

This paper is related to our activities on acoustic emission (AE). At present, acoustic emission transducers are being developed for low and high temperature. A test to detect electrical discharges in electrical transformers was performed. Our experience in industrial tests in detecting cracks or failures in tanks or tubes is also described. The use of AE for leak detection is considered. Works on pattern recognition of AE signals are also being performed. DOE

N92-14797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A SURVEY OF THE BROADBAND SHOCK ASSOCIATED NOISE PREDICTION METHODS
Chan M. Kim, Eugene A. Krejsa, and Abbas Khavaran (Sverdrup Technology, Inc., Brook Park, OH.) 1992 26 p Proposed for presentation at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(Contract NAS3-25266)
(NASA-TM-105365; E-6743; NAS 1.15:105365; AIAA-92-0501)
Avail: NTIS HC/MF A03 CSCL 20A

Several different prediction methods to estimate the broadband shock associated noise of a supersonic jet are introduced and compared with experimental data at various test conditions. The nozzle geometries considered for comparison include a convergent and a convergent-divergent nozzle, both axisymmetric. Capabilities and limitations of prediction methods in incorporating the two nozzle geometries, flight effect, and temperature effect are discussed. Predicted noise field shows the best agreement for a convergent nozzle geometry under static conditions. Predicted results for

nozzles in flight show larger discrepancies from data and more dependable flight data are required for further comparison. Qualitative effects of jet temperature, as observed in experiment, are reproduced in predicted results. Author

N92-14798# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
PROPELLER-DRIVEN-SMALL AIRPLANE NOISE CERTIFICATION
G. J. J. Ruijgrok and D. M. vanPaassen Dec. 1990 31 p
(LR-650; ETN-92-90417) Avail: NTIS HC/MF A03

The existing international standards and recommended practices for light propeller driven airplane noise as published in annex 16 to the Convention on International Civil Aviation are reviewed. These airplanes are defined as having a maximum certificated takeoff mass below 9000 kg. The determination of atmospheric attenuation rate and the establishment of a confidence level are discussed. ESA

N92-13976# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
AEROACOUSTICS
G. W. Johnston, E. DellaPenna, S. Picket, M. Ohayon, M. Titcombe, and M. Langlois *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 52-53 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-14799# Brookhaven National Lab., Upton, NY.
THE NEW BNL POLARIZED NEGATIVE ION SOURCE
A. I. Hershcovitch, J. G. Alessi, B. DeVito, and A. E. Kponou 28 Aug. 1991 10 p Presented at the 4th International Conference on Ion Sources, Bensheim, Fed. Republic of Germany, 30 Sep. - 4 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-000134; BNL-45962; CONF-910943-2) Avail: NTIS HC/MF A02

A new ground state source of negative hydrogen ions with polarized nuclei (r-vector H(-)) is being developed at BNL. Extensive developmental research has been aimed at improving each element of r-vector H(-) production: cold H(0) beam, spin selection and focusing magnets, and ionizer. These elements have recently been integrated into a source. A first test with the accommodator nozzle cooled only to liquid nitrogen temperatures resulted in 5 micro-A of H(-). Tests at liquid helium temperatures are being initiated. DOE

N92-14800# Argonne National Lab., IL.
Z(SUP 0) YIELDS HADRONS IN SDC
A. B. Wicklund 30 Aug. 1991 12 p
(Contract W-31-109-eng-38)
(DE92-000294; ANL-HEP-TR-91-74; SDC-91-00081) Avail: NTIS HC/MF A03

We report on a study of hadronic Z degrees decays at high P(sub t)(P(sub t) greater than 500 GeV/c), at 40 TeV CM energy. Our goal here is to understand the effects of the kinematics of Z degrees decay, especially the Lorentz boost, on detection issues. We used an ISAJET sample of Drell Yan events, requiring the Z degrees to have pseudorapidity (eta) in (-1.5,1.5) and P(sub t) greater than 500 GeV/c. ISAJET forces the Z degrees to decay to two primary partons, which then cascade by gluon and quark emission to stable hadrons. We excluded Z degrees yields nu bar nu decays. In about 10 percent of the hadronic decays, significant energy is lost due to neutrino emission from heavy quarks, so that the hadronic mass is significantly less than the Z degrees mass generated; these events were not explicitly removed. We treated muons like other hadrons, assuming that high P(sub t) muons could be identified and corrected for. For this study we retained only the stable daughter particles in Z degrees decay, labelled according to their parton parentage (Jet 1 or 2). We ignored the particles from the underlying event and from other final state jets. These contributions, along with other non-Z degrees noise, can be explicitly added back for relevant studies.) Finally, we note that the Z degrees decay angular distribution is approximately flat for these events, not peaked at 90 deg. as in Higgs (yields) Z degrees Z degrees; this will have little effect on our conclusions. To avoid very asymmetric decays, we required each of the two jets to satisfy P(sub t) greater than 100 GeV/c. DOE

N92-14801*# Oregon Univ., Eugene. Dept. of Physics.
HIGH TEMPERATURE ELECTRONIC EXCITATION AND IONIZATION RATES IN GASES Final Report
Frederick Hansen 5 Dec. 1991 24 p
(Grant NAG1-1211)
(NASA-CR-189496; NAS 1.26:189496) Avail: NTIS HC/MF A03 CSCL 20H

The relaxation times for electronic excitation due to electron bombardment of atoms was found to be quite short, so that electron kinetic temperature (T sub e) and the electron excitation temperature (T asterisk) should equilibrate quickly whenever electrons are present. However, once equilibrium has been achieved, further energy to the excited electronic states and to the kinetic energy of free electrons must be fed in by collisions with heavy particles that cause vibrational and electronic state transitions. The rate coefficients for excitation of electronic states produced by heavy particle collision have not been well known. However, a relatively simple semi-classical theory has been developed here which is analytic up to the final integration over a Boltzmann distribution of collision energies; this integral can then be evaluated numerically by quadrature. Once the rate coefficients have been determined, the relaxation of electronic excitation energy can be evaluated and compared with the relaxation rates of vibrational excitation. Then the relative importance of these two factors, electronic excitation and vibrational excitation by heavy particle collision, on the transfer of energy to free electron motion, can be assessed. Author

N92-14802# Georgia Inst. of Tech., Atlanta. School of Physics.
TERMOLECULAR ASSOCIATION AND LASER-ASSISTED ELECTRON-(EXCITED) ATOM COLLISIONS Annual Report, 1 Jul. 1990 - 30 Jun. 1991
M. R. Flannery 23 Aug. 1991 134 p
(Grant AF-AFOSR-0426-89; AF Proj. 2301)
(AD-A241647; AFOSR-91-0818TR) Avail: NTIS HC/MF A07 CSCL 20/5

Theoretical research was conducted in the following areas: (1) laser assisted electron (excited) atom collisions; (2) electron atom collisions ; and (3) termolecular association. Additionally, a summary of papers presented, papers published, and abstracts of the published papers is given. GRA

N92-14803# Westinghouse Hanford Co., Richland, WA.
JUSTIFICATION FOR REPORTING NEGATIVE VALUE COUNTING RESULTS AS AN ALTERNATIVE TO MINIMUM DETECTABLE ACTIVITY
G. L. Troyer, R. C. Brown, and R. A. Jones Mar. 1991 19 p Presented at the International Topical Conference on Methods and Applications of Radioanalytical Chemistry II (MARC-2), Kona, HI, 21-27 Apr. 1991
(Contract DE-AC06-87RL-10930)
(DE91-018165; WHC-SA-1019; CONF-910422-4) Avail: NTIS HC/MF A03

Proper measurements of sample radioactivity require removal of background activity as a final step in generating an analytical result. When the sample response is within the standard deviation of the background activity, results often are reported as less than detectable or at a minimum detectable activity (MDA) value. Using the MDA creates a truncated distribution or censored data situation. Where a sample point has repeated measurements a bias is introduced. Further, real results can have analytical error

statements. These error statements are lost when a MDA is reported. Investigation of a large number of net counting data for low activity sample points suggests that reporting negative results can provide more information than merely truncating to the MDA when results are near background activities. Four cases are examined: method performance, determination of low level activities, general background stability, and quality of results.
DOE

N92-14804# Tennessee Univ., Knoxville.
A STUDY OF LANTHANIDE FLUORESCENCE SHIFTS CAUSED BY NEAR NEIGHBOR PERTURBATION Ph.D. Thesis
N. A. Stump Dec. 1991 120 p
(Contracts DE-FG05-88ER-13865; DE-AC05-84OR-21400)
(DE91-018532; DOE/ER-13865/042) Avail: NTIS HC/MF A06

Lanthanide ions, unlike ions formed by the d-block elements, characteristically exhibit narrow electronic spectral features, usually on the order of one to two wavenumbers. The spectral position and intensity of these features are dependent upon the environmental symmetry of the lanthanide ion. Any perturbation in the coordination sphere, such as a change in bond distance, or a shift to another geometrical polyhedron, will ordinarily cause a change in the observed spectrum. These two characteristics (narrow line spectra and environmental sensitivity) make the lanthanide ions particularly useful for the study of symmetry, coordination, and crystal structure in solid and dissolved compounds in which they are a major or a minor constituent. Such compounds could also be employed for the study of impurities, coordination numbers, absorption of solvent molecules, and anything else that might perturb the environment around the lanthanide ion. The present work describes the theoretical background required, the instrumentation employed, the syntheses attempted, and the spectral evaluations completed for several europium-containing molecules. A special emphasis was placed upon europium-containing chelates. Europium was chosen because of its simple-appearing electronic spectrum and its readily excited emission in the visible region of the electromagnetic spectrum.
DOE

N92-14805# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
NEW PARAMETRIZATION OF MULTIPLICITY DISTRIBUTION IN PP AND P(-P) INELASTIC INTERACTIONS
O. G. Chikilev and P. V. Shlyapnikov 1990 18 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE91-637100; IFVE-ONF-90-149) Avail: NTIS HC/MF A03

It is shown that two-parameter function P(sub N)(delta,b) obtained on the assumption that three sources (superclusters) are produced during the first interaction phase and afterwards evolve into clusters with Poisson distribution of secondary particles with mean multiplicity b, well describes experimental data on negatively charged particle multiplicity distributions in pp and p(-p) interactions. The data show that the parameter b rises with CMS energy square root of s as 1n(square root of s) while the second parameter (delta) is practically energy independent.
DOE

N92-14806# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
QUARKS IN THE INSTANTON VACUUM. 1: QUARK PROPAGATOR
P. V. Pobylitsa 1990 38 p In RUSSIAN; ENGLISH summary
(DE91-637129; LIYaF-1598) Avail: NTIS HC/MF A03

A systematic theory of quarks in the dilute instanton medium is suggested. All the graphs for the quark propagator surviving at large number of colors are summed up and a closed equation for the quark propagator in the instanton medium is obtained. The chiral symmetry is shown to be spontaneously broken.
DOE

N92-14807# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
HYDRODYNAMICAL ANALYSIS OF AZIMUTHAL TWO-PARTICLE CORRELATIONS IN RELATIVISTIC HEAVY-ION COLLISIONS
V. N. Russkikh 1990 28 p
(DE91-637356; IAE-5002-2) Avail: NTIS HC/MF A03

Azimuthal two-particle correlations in heavy-ion collisions with the energy E(sub lab) is approximately 1 GeV/nucleon have been calculated in the three-dimensional hydrodynamic model. The results of calculation of the proton-proton correlation for a heavy target (C + Pb, E(sub lab) = 3.6 GeV/nucleon) reproduce the experimental data obtained at the Dubna synchrophasotron fairy well. The dependence of model results on nuclear compressibility is discussed.
DOE

N92-14808# California Univ., Berkeley. Lawrence Berkeley Lab.
DYNAMIC-ANGLE SPINNING AND DOUBLE ROTATION OF QUADRUPOLAR NUCLEI Ph.D. Thesis
K. T. Mueller Jul. 1991 256 p
(Contract DE-AC03-76SF-00098)
(DE92-000837; LBL-31125) Avail: NTIS HC/MF A12

Nuclear magnetic resonance (NMR) spectroscopy of quadrupolar nuclei is complicated by the coupling of the electric quadrupole moment of the nucleus to local variations in the electric field. The quadrupolar interaction is a useful source of information about local molecular structure in solids, but it tends to broaden resonance lines, causing crowding and overlap in NMR spectra. Magic-angle spinning, which is routinely used to produce high resolution spectra of spin-1/2 nuclei like carbon-13 and silicon-29, is incapable of fully narrowing resonances from quadrupolar nuclei when anisotropic second-order quadrupolar interactions are present. Two new sample-spinning techniques are introduced here that completely average the second-order quadrupolar coupling. Narrow resonance lines are obtained and individual resonances from distinct nuclear sites are identified. In dynamic-angle spinning (DAS) a rotor containing a powdered sample is reoriented between discrete angles with respect to high magnetic field. Evolution under anisotropic interactions at the different angles cancels, leaving only the isotropic evolution of the spin system. In the second technique, double rotation (DOR), a small rotor spins within a larger rotor so that the sample traces out a complicated trajectory in space. The relative orientation of the rotors and the orientation of the larger rotor within the magnetic field are selected to average both first- and second-order anisotropic broadening. The theory of quadrupolar interactions, coherent averaging theory, and motional narrowing by sample reorientation are reviewed with emphasis on the chemical shift anisotropy and second-order quadrupolar interactions experienced by half-odd integer spin quadrupolar nuclei. The DAS and DOR techniques are introduced and illustrated with application to common quadrupolar systems such as sodium-23 and oxygen-17 nuclei in solids.
DOE

N92-14809# International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section.
UENDL/NAA: USSR EVALUATED NUCLEAR DATA LIBRARY FOR NEUTRON ACTIVATION ANALYSIS
A. B. Pashchenko Nov. 1990 76 p
(DE91-624093; IAEA-NDS-125(Rev-0)) Avail: NTIS HC/MF A05

This document describes contents and format of the USSR Evaluated Nuclear Data library for Neutron Activation Analysis. It contains recommended values for activation cross-sections of 14.5 MeV energy neutrons and neutrons from U-235 and Cf-252 fission; for resonance integrals of capture, absorption and fission reactions; for thermal neutron capture and absorption reaction cross-sections; for effective resonance energy values; for the main gamma-ray energies of neutron capture and for their absolute intensities; for half-lives and abundance for all known nuclides.
DOE

N92-14810# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ANTIPARTICLES
V. N. Streltsov 1989 9 p
(DE91-636031; JINR-E-2-89-32) Avail: NTIS HC/MF A02

It is stressed that one of principal consequences following from the introduction of the Minkowski space and of its conjugate

energy-momentum space is the existence of objects exhibiting negative energy and moving backward in time. With account of the reinterpretation principle, the above signifies the existence of antiparticles. It is noted that within the framework of this approach the well-known difficulties inherent in the Dirac vacuum are removed. The conclusion is made that the violation of T-invariance in weak interactions should be accompanied by a violation of the law of lepton charge conservation. Attention is drawn to the fact that (as a consequence of the relativization of space-time coordinates) non-conservation of spatial parity must necessarily be closed to the violation of T-invariance. DOE

N92-14811# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ANISOTROPIC SPACE-TIME
V. N. Streltsov 1989 18 p
(DE91-636032; JINR-E-2-89-333) Avail: NTIS HC/MF A03

A conventional character of the concept of simultaneity and distance in the special theory of relativity is discussed. Lorentz-Edwards transformations taking into account explicity allowable time anisotropy are considered. Experimentally permissible space anisotropy is introduced by the gauge transformation of a spatial coordinate in the Lorentz formulae. Finally the possibility of introducing anisotropic space-time within the stated conventions is considered. Corresponding generalized Lorentz transformations, expressions for one-way velocities, right and left distances for material bodies, etc. are obtained. The possibility of generalizing the Lobachevsky geometry to anisotropic velocity space is also discussed. The use of right and left Feynman clocks (made on the basis of parity nonconservation) is suggested for practical realization of anisotropic time-space. Characteristic properties of anisotropic (noncommutative) geometry are considered. DOE

N92-14812# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
PROGRAM COMPLEX FOR PROBLEMS OF ATOMIC PHYSICS, PART 3 [KOMPLEKS PROGRAMM DIYA ZADACH ATOMNOJ FIZIKI, CHAST 3]
V. A. Dzyuba 1990 30 p In RUSSIAN
(DE91-636263; IYaF-90-9) Avail: NTIS HC/MF A03

Realization of two methods of calculations of correlation corrections in atoms by direct summation according to multiparticle perturbation theory and by means of the Feynman diagram technique is described. Calculation in the Feynman diagram technique is more clumsy, but it possesses better numerical accuracy and permits to sum accurately dominating classes of high-order diagrams. Application of the methods is illustrated using cesium and thallium atoms. DOE

N92-14813# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
A SEARCH FOR CHARGED HIGGS BOSONS AT TRISTAN
I. Adachi, H. Aihara, and M. Doser (National Lab. for High Energy Physics, Ibaraki, Japan) May 1990 16 p
(DE91-767869; INS-813) Avail: NTIS HC/MF A03

We searched for pair production of charged Higgs bosons via proton antiproton annihilation, using data (23.3pb(exp -1)) collected by the TOPAZ detector in the energy range sq root of s = 52.0 similar to 61.4GeV. We observed no evidence for charged Higgs pair production and extended the excluded region in the M sub H + or - BR(hadron) plane. The 95 pct. CL lower mass limit is the most stringent for BR(hadron) = 0.6, giving M(sub H)+ or - greater than 22 GeV. DOE

N92-14814# Washington Univ., Seattle. Dept. of Physics.
INTERPLAY BETWEEN PION ABSORPTION AND INCLUSIVE-INELASTIC SCATTERING ON HYDROGEN AND HELIUM ISOTOPES FOR 96.5-MeV KINETIC ENERGY PIONS
D. W. Storm 1991 6 p Presented at the 5th Mesons and Light Nuclei, Prague (Czechoslovakia), 1-6 Sep. 1991
(Contract DE-FG06-90ER-40537)
(DE92-000825; DOE/ER-40537/9; CONF-9109291-1) Avail: NTIS HC/MF A02

Measurements of double-differential cross sections for inclusive-inelastic scattering of 96.5-MeV pions from hydrogen and helium isotopes are presented. Differential and angle-integrated cross sections are obtained. Distorted wave impulse approximation calculations are reported. The interplay between inclusive-inelastic scattering and pion absorption is discussed. DOE

N92-14815# California Univ., Berkeley. Lawrence Berkeley Lab.
LASER DIAGNOSTICS OF H(-) FORMATION IN A MAGNETIC MULTICUSP ION SOURCE
A. T. Young, P. Chen, W. B. Kunkel, K. N. Leung, C. Y. Li, and G. C. Stutzin May 1991 3 p Presented at the 1991 Institute of Electrical and Electronics Engineers (IEEE) Particle Accelerator Conference (PAC), San Francisco, CA, 6-9 May 1991
(Contract DE-AC03-76SF-00098)
(DE92-000940; LBL-29987; CONF-910505-412) Avail: NTIS HC/MF A01

The populations of ground electronic state atomic hydrogen and ground electronic state, vibrationally-rotationally excited hydrogen molecules in a negative hydrogen ion source discharge have been measured using vacuum ultraviolet (VUV) laser absorption spectroscopy. Vibrational states up to v equals 8 and rotational levels as high as J equals 15 have been measured. The measurements have been made under a range of discharge conditions. The complete vibrational population distribution for v equals 1-8, J equals 1 has been obtained. The vibrational distribution appears to be thermalized and does not exhibit a plateau at the higher vibrational levels, in contrast to most models of this system. In contrast, the high rotational states are populated suprathermally. These determinations indicate that rotationally excited molecules may play an important role in the production of H(-) in these sources. DOE

N92-14816# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
SHELL POTENTIAL AND ITS APPLICATION IN SPUTTERING THEORY
N. M. Kuzmina and Yu. V. Kuzmin 1989 13 p In RUSSIAN
(DE91-623660; NIIYaF-MGU-89-15-92) Avail: NTIS HC/MF A03

Analytical potential which permits taking into account the shell structure of atom at quasiclassical level is suggested. Using the analytical potential, the spectrum of recoil atoms appearing in case of bombardment of solid bodies by fast ions has been calculated. DOE

N92-14817# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
SPACE-TIME STRUCTURE OF HADRON INTERACTION
L. I. Belzer, V. A. Bodyagin, A. M. Gribushin, I. N. Vardanyan, A. A. Ershov, L. I. Sarycheva, and N. B. Sinev 1989 8 p In RUSSIAN
(DE91-623947; NIIYaF-MGU-89-56-133) Avail: NTIS HC/MF A02

Experiment with a fixed target in p, (pi) and K beams of intermediate energies (10-20 GeV) is carried out t trace the evolution of nonequilibrium hadron states passing through a nuclear substance in search of the most characteristic manifestations of the mechanism of quark hadronization. Differential cross sections of leading hadron generation L on nuclear targets from hydrogen to lead are measured for semiinclusive reaction hA yields L+X sub eta, where X sub eta is selection of events with certain configuration of tracks corresponding to incoherent channels with required pulse transfer from initial particle to (Delta)P target or interaction range (Delta)z approx. Planck constant/(Delta)P. DOE

N92-14818# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CLASSICAL THEORY OF A STRUCTURAL POINT OBJECT IN THE 2ND ORDER APPROXIMATION

Eh. Eh. Ehntralgo 1989 16 p In RUSSIAN; ENGLISH summary
(DE91-628031; JINR-R-2-89-313) Avail: NTIS HC/MF A03

A closed system of classical equations of the motion describing a structural point object with the help of four constants (mass m), charge (e), gyromagnetic factor (g), characteristic frequency (omega) and fifteen independent variables (coordinate q-vector, kinetic momentum p-vector, dipole moment d-vector, dipole speed f-vector, spin s-vector) are obtained. The considered system of equations of motion provides the exact fulfilment of the conservation laws for the energy and for the square of spin of a particle. DOE

N92-14819# Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil).
DETERMINATION OF ENERGY DISTRIBUTION FOR PHOTON AND NEUTRON MICRODOSIMETRY Ph.D. Thesis
A. S. Todo 1989 165 p In PORTUGUESE; ENGLISH summary
(DE91-640663; INIS-BR-2648) Avail: NTIS HC/MF A08

This work was undertaken to provide basic physical data for use in both microdosimetry and dosimetry of high energy photons and also in the neutron radiation field. Described is the formalism to determine the initial electron energy spectra in water irradiated by photons with energies up to 1 GeV. Calculations were performed with a Monte Carlo computer code, PHOEL-3, which is also described. The code treats explicitly the production of electron-positron pairs, Compton scattering, photoelectric absorption, and the emission of Auger electrons following the occurrence of K-shell vacancies in oxygen. The tables give directly the information needed to specify the absolute single-collision kerma in water, which approximates tissue, at each photon energy. Results for continuous photon energy spectra can be obtained by using linear interpolation with the tables. The conditions under which first-collision kerma approximate absorbed dose are discussed. A formula is given for estimating bremsstrahlung energy loss, one of the principal differences between kerma and absorbed dose in practical cases. A study has been carried out, on the use of cylindrical, energy-proportional pulse-height detector for determining microdosimetric quantities, as neutron fractional dose spectra, D (L), in the function of linear energy transfer (LET). In the present study the Hurst detector was used; this device satisfies the requirement of the Bragg-Gray principle. A Monte Carlo Method was developed to obtain the D(L) spectrum from a measured pulse-height spectrum H(h), and the knowledge of the distribution of recoil-particle track lenght, P(T) in the sensitive volume of the detector. These developed programs to find P(T) and D(L) are presented. The distribution of D(L) in LET were obtained using a known distribution of P(T) and the measured H(h) spectrum fromthe Cf-2 52 neutron source. All the results are discussed and the conclusions are presented. DOE

N92-14820# International Atomic Energy Agency, Vienna (Austria).
ISOTOPES IN EVERYDAY LIFE
H. Seligman, ed. and V. A. Gillen, ed. Dec. 1990 67 p
(DE91-642281; INIS-mf-12892) Avail: NTIS HC/MF A04

Isotopes represent a tool which can do certain jobs better, easier, quicker, more simply and cheaper than competitive methods. Some measurements could not be done at all without the use of isotopes as there are no alternative methods available. A short review of these tools of science in their different fields is given. Applications are discussed for food and agriculture, human health, industry, hydrology, geology, geochemistry, geophysics and dating, environment, and basic scientific research. DOE

N92-14821# Los Alamos National Lab., NM.
GEOMAGNETIC TRAPPING AND PROMPT DETECTION OF PROTONS FROM AN ORBITAL NEUTRAL PARTICLE BEAM
R. J. Hughes and W. B. Cottingame Oct. 1991 24 p
(Contract W-7405-eng-36)
(DE92-000659; LA-12150-MS) Avail: NTIS HC/MF A03

Copious quantities of protons are emitted during the operation of a neutral-particle-beam (NPB) accelerator system. If the system is operated in Earth orbit, these protons have the potential for becoming trapped in the Earth's magnetic field. In this paper, the evolution of the proton population at short times after injection from an NPB platform of modest capability operated at low altitudes and low latitudes is studied. In particular, protons that are injected below the intense proton radiation belts and that have lifetimes long enough to allow them to survive many drift periods are considered. The probability of intercepting these trapped protons and the magnitude of the associated flux within a few drift periods of injection are estimated. The possibility of monitoring the space environment for the characteristic signals of such trapped protons is discussed as a method for detecting the operation of an NPB in low-Earth orbit. DOE

N92-14822# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
ON THE ELECTRODYNAMICS OF SPINNING PARTICLES
J. W. vanHolten 5 Dec. 1990 29 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(NIKHEF-H/90-22; ETN-92-90443) Avail: NTIS HC/MF A03

A modification of the Lorentz force law is introduced, which can be interpreted as a classical limit of the Dirac Klein Gordon equations. An improved version of the inhomogeneous Maxwell equation is constructed to describe the classical fields of spinning particles. The lifetime of unstable charged particles moving in a Coulomb field is computed for both spin zero and spin half particles. Comparison shows spin effects to be present, but to be relatively small. The magnitude of further spin dependent corrections from hyperfine interactions is computed. Similar effects are shown to arise in nonabelian gauge theories such as Quantum ChromoDynamics (QCD). ESA

N92-14823# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
CLASSICAL AND QUANTUM MECHANICS OF A SPINNING PARTICLE INTERACTING WITH BACKGROUND FIELDS
R. H. Rietdijk 27 Mar. 1991 17 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(NIKHEF-H/91-06; ETN-92-90448) Avail: NTIS HC/MF A03

The most general supersymmetric theory is examined. Interactions of a spinning particle with the gravitational field and with other types of background fields are considered. The canonical analysis of the theories examined is performed, and their invariance is established. The generalization of results to higher derivative theories is discussed. The index theorem for the corresponding Dirac operator is extended to take into account the effect of additional background fields, and in particular the effect of exact torsion forums. ESA

N92-14824# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
PRODUCTION OF NEUTRINOS AT HERA
M. M. J. F. Janssen 1991 29 p
(NIKHEF H/91-07; ETN-92-90449) Avail: NTIS HC/MF A03

The production of neutrinos accompanied with one or more leptons is considered. It provides a clean signal for the production of W or Z bosons. The background processes to determine the relevance of the final states are discussed. Complete tree level calculations of the matrix elements without additional approximations are presented. A classification of all processes with neutrinos in the final state and numerical results are given. The choices which were made for the quark and gluon distribution and the quark and gluon evolution scale are discussed. The amplitude level techniques used in the calculation, and the method for evaluating three particle amplitudes are described. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N92-14825# Brown Univ., Providence, RI.
APPLICATIONS OF NEURAL NETWORKS IN HIGH ENERGY PHYSICS
D. Cutts, J. S. Hoftun, D. Nesic, A. Sornborger, C. R. Johnson, and R. T. Zeller (Zeller Research Ltd., Bristol, RI.) 1990 9 p Presented at the Computing in High Energy Physics, Santa Fe, NM, 9-13 Apr. 1990
(Contract DE-AC02-76ER-03130)
(DE90-013325; DOE/ER-03130/52; COO-3130TC-52; CONF-9004190-13) Avail: NTIS HC/MF A02

Neural network techniques provide promising solutions to pattern recognition problems in high energy physics. We discuss several applications of back propagation networks, and in particular describe the operation of an electron algorithm based on calorimeter energies. DOE

N92-14826# Los Alamos National Lab., NM.
HIGH-BRIGHTNESS INJECTORS FOR HADRON COLLIDERS
T. P. Wangler 1990 22 p Presented at the 4th Joint US-CERN School on Particle Accelerators: Course on Frontiers of Particle Beams: Intensity Limitations, Hilton Head Island, SC, 7-14 Nov. 1990
(Contract W-7405-eng-36)
(DE92-000208; LA-UR-91-3012; CONF-901165-2) Avail: NTIS HC/MF A03

The counterrotating beams in collider rings consist of trains of beam bunches with N(sub B) particles per bunch, spaced a distance S(sub B) apart. When the bunches collide, the interaction rate is determined by the luminosity, which is defined as the interaction rate per unit cross section. For head-on collisions between cylindrical Gaussian beams moving at speed beta c, the luminosity is given by L = N(sub B)(exp 2) beta c/(4pi sigma(exp 2)S(sub B)), where sigma is the rms beam size projected onto a transverse plane (the two transverse planes are assumed identical) at the interaction point. This beam size depends on the rms emittance of the beam and the focusing strength, which is a measure of the 2-D phase-space area in each transverse plane, and is defined in terms of the second moments of the beam distribution. Our convention is to use the rms normalized emittance, without factors of 4 or 6 that are sometimes used. The quantity, tilde beta*, is the Courant-Synder betatron amplitude function at the interaction point, a characteristic of the focusing lattice, and gamma is the relativistic Lorentz factor. Achieving high luminosity at a given energy, and at practical values of tilde beta* and S(sub B), requires a large value for the ratio N(sub B)(sup 2)/ epsilon(sub n), which implies high intensity and small emittance. Thus, specification of the luminosity sets the requirements for beam intensity and emittance, and establishes the requirements on the performance of the injector to the collider ring. In general, for fixed N(sub B), the luminosity can be increased if epsilon(sub n) can be reduced. The minimum emittance of the collider is limited by the performance of the injector; consequently the design of the injector is of great importance for the ultimate performance of the collider. DOE

N92-14827# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
TO ACCELERATION AND FOCUSING THEORY IN RF QUADRUPOLES
Yu. A. Budanov 1990 16 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE91-638997; IFVE-OLU-90-40) Avail: NTIS HC/MF A03

The questions of particle dynamics in accelerators with space-periodic RFQ focusing using the pi-type standing wave are considered. The formation of accelerating efficiency on the axis of the multielectrodes with arbitrary number of intermediate electrodes is treated. The efficiency vector sum rule for separated gaps is obtained. The main expressions for transverse motion stability are obtained for arbitrary focusing channels. Concrete formulae for the characteristic value of motion equations with FD and FFDD focusing are given. The comparison of the expressions obtained with numerical calculations is proposed. DOE

N92-14828# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
ELECTROHYDRODYNAMIC EMITTERS OF ION BEAMS [EHLEKTROGIDRODINAMICHESKIE EHMITTERY IONNYKH PUCHKOV]
V. G. Dudnikov and A. L. Shabalin 1990 30 p In RUSSIAN
(DE91-636293; IYaF-90-31) Avail: NTIS HC/MF A03

Physical processes determining generation of ion beams with high emission current density in electrohydrodynamic emitters are considered. Electrohydrodynamic effects developing in ion emission features and kinetics of ion interaction in beams with high density are discussed. Factors determining the size of the emission zone, emission stability at high and low currents, cluster generation, increase of energy spread, and decrease of brightness are analyzed. Problems on practical provision of stable EHD emitter functioning are considered. DOE

N92-14829# Academy of Sciences of the Ukrainian SSR, Kharkov. Inst. Problem Mashinostroeniya.
QUASI-ANALOGUE METHOD FOR DETERMINATION THERMAL CONTACT RESISTANCE [KVAZIANALOGOVYJ METOD OPREDELENIYAMTERMICHESKIKH KONTAKTNYKH SOPROTIVIENIJ]
O. S. Tsakanyan and N. A. Koshevaya 1989 19 p In RUSSIAN
(DE91-638960; IPMash-305) Avail: NTIS HC/MF A03

Method for solution of inverse problem of thermal conductivity using identification of the 4th kind boundary conditions by the method of parametric optimization is suggested. The temperature of the contact surface is approximated by parametric functions and the inverse problem solution is reduced to search for parameters of these functions. The flowsheet of the device for realizing the 4th kind boundary conditions is described. Statement and solution of two-dimensional problem of determining thermal contact resistances between two contacting bodies are presented. DOE

N92-14830# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
NONLINEAR COHERENT BEAM-BEAM OSCILLATIONS IN THE RIGID BUNCH MODEL
N. Dikansky and D. Pestrikov 1990 24 p
(DE91-639001; IYaF-90-14) Avail: NTIS HC/MF A03

Within the framework of the rigid bunch model, coherent oscillations of strong-strong colliding bunches are described by equations which are specific for the weak-strong beam case. In this paper some predictions of the model for properties of nonlinear coherent oscillations as well as for associated limitations of the luminosity are discussed. DOE

N92-14831# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
DYNAMICAL CHAOS AND BEAM-BEAM MODELS
F. M. Izrailev 1990 20 p
(DE91-639002; IYaF-90-16) Avail: NTIS HC/MF A03

Some aspects of the nonlinear dynamics of beam-beam interaction for simple one-dimensional and two-dimensional models of round and flat beams are discussed. The main attention is paid to the stochasticity threshold due to the overlapping of nonlinear resonances. The peculiarities of a round beam are investigated in view of using the round beams in storage rings to get high luminosity. DOE

N92-14832# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
RADIATIVE INCREASE OF BEAM EMITTANCE IN THE FINAL LENSE OF A LINEAR COLLIDER
T. A. Vsevolozhskaya 1990 9 p In RUSSIAN
(DE91-639003; IYAF-90-41) Avail: NTIS HC/MF A02

Increase of electron beam cross emittance due to quantum fluctuations of synchrotron radiation in rectangular focusing elements is considered. The general expression for emittance increase and its analysis for a plane beam with size ratio x much greater than y in final quadrupole of a linear collider is presented. Emittance, Ey, in this case is increased exponentially with the factor constant (E sub x/2 beta sub ox) (exp 3/2) beta sub oy (exp 2) determined by values of beta functions in the place of colliding and by the emittance by a with the constant depending on energy as E(exp 5) and being of an order of 10(exp 5) sq m at E-1 TeV for focusing by y close to quarter-wave or more. DOE

N92-14833# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
PROGRAM FOR NUMERICAL SIMULATION OF NON-AXIALLY SYMMETRICAL ELECTRON BEAM TRANSPORT IN LONG CHANNELS
A. V. Larionov 1990 17 p In RUSSIAN
(DE91-639062; IYAF-90-19) Avail: NTIS HC/MF A03

The BEAMS program designed for simulation non-axially symmetrical electron beam transport at paraxial approximation is described. The method of large particles with particles in the form of linear charges is used. The program is realized for the ES-1061 and VAX-780 computers. The results of test calculations for a beam 0.8 cm in-diameter at 1 MeV energy, beam current of 300 A, and magnetic field of 959 Gs are presented. Values, pulsation amplitudes, and beam emittance are obtained. DOE

N92-14834# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE HIGH-ENERGY POTENTIAL SCATTERING THEORY IN THE METHOD OF EVOLUTION WITH RESPECT TO COUPLING CONSTANT
M. Kh. Khankhasaev 1989 16 p In RUSSIAN; ENGLISH summary
(DE91-628032; JINR-R-2-89-754) Avail: NTIS HC/MF A03

The formulation of the potential scattering theory is considered which is based on the low of evolution of the system with respect to the coupling constant (the CCE-method). The new equation for the total scattering amplitude is derived within the framework of this approach. A method of solving this equation which is effective in the short wave limit is proposed. The relationship of the CCE-method with the phase function method in quantum mechanics is discussed. DOE

N92-14835# Institute of Nuclear Physics, Krakow (Poland).
PHASE-SPACE CONSTRAINTS ON INCLUSIVE ENERGY SPECTRA OF HEAVY ION FRAGMENTATION AT INTERMEDIATE ENERGIES
A. Szczurek and A. Budzanowski 1990 21 p
(DE91-641867; INP-1492/PL) Avail: NTIS HC/MF A03

It is shown that the final state density, the so-called phase-space factor, strongly influences the observed energy spectra, leading to a considerable reduction of the width of the fragmentation bump at intermediate (10-100 MeV/A) energies. This reduction, while practically independent of the target, depends on both the projectile and the observed fragment. When the phase-space factor is taken into account, the energy where the cross section takes a maximum is shifted towards low energy. The lower the incident energy, the more shifted the maximum of the cross section. The effects discussed are consistent with those found experimentally. The excitation energy of the particles accompanying the observed spectator particles causes an additional reduction of the high-energy side of the fragmentation bump. Bump of multifragmentation is shifted towards lower energies. DOE

N92-14836# Stanford Linear Accelerator Center, CA.
FIELD CALCULATION ALGORITHM FOR GENERAL BEAM DISTRIBUTIONS
S. Krishnagopal (California Univ., Berkeley. Lawrence Berkeley Lab.) and R. Siemann Aug. 1991 4 p
(Contract DE-AC03-76SF-00515)
(DE92-002017; SU-SLAC/AP-90; LBL-31094) Avail: NTIS HC/MF A01

This note is a summary of the algorithm used in our recent paper on the coherent beam-beam interaction. The goal of the work was to study coherent beam-beam interactions, and the development needed was to avoid using the expression for the beam-beam generated fields that assumes a Gaussian beam distribution. Because of our interest in round beams the algorithm was developed for use with beams that are approximately round. We believe there is a similar approach for flat beams, but the Fourier series discussed below probably isn't the right basis for expansion. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N92-14837# Rome Lab., Griffiss AFB, NY.
ADAPTIVE OPTICAL PROCESSOR Report, Feb. 1989 - Jan. 1991
Michael J. Ward, Christopher W. Keefer, and Stephen T. Welstead Aug. 1991 42 p Prepared in cooperation with Colsa, Inc., Huntsville, AL
(AD-A241535; RL-TR-91-270) Avail: NTIS HC/MF A03 CSCL 20/6

The Phase 1 in-house effort to develop an optical processor as an electronic counter-counter-measure for radar multipath is discussed. The closed loop system demonstrates the ability to achieve a 15.2 +/- 2.4 dB adaptive cancellation of a single tone, single delay jamming signal over a 1-5 MHz bandwidth. The open loop optical system proves capable of providing a 30.2 +/- 3.9 dB cancellation of the same signal when using operator provided information. Key elements of this project include the characterization and selection of a spatial light modulator (SLM) system and the development of a software package which assists the minimization process. This has resulted in the novel use of a two dimensional binary SLM to perform as an enhanced grey scale one dimensional SLM. Additionally, an acousto-optic (AO) deflector has been demonstrated to provide the grey level dynamic range and spatial resolution required by the system. The results of this single channel testbed will be used in the future development of a multichannel optical processor. GRA

N92-14838# Department of the Army, Washington, DC.
WHITE LIGHT OPTICAL FOURIER TRANSFORM DEVICE Patent Application
John L. Johnson, inventor (to Army) 9 Sep. 1991 15 p
(AD-D015022; US-Patent-Appl-SN-757054) Avail: NTIS HC/MF A03 CSCL 20/6

A White Light Optical Fourier Transform Device, (hereinafter referred to as the Transform Device), comprised of symmetrically positioned birefringent crystal wedges and a half-wave plate inserted between them is placed in the path of light, incoming at an angle of incidence. The Transform Device functions in both coherent and incoherent lights to produce the Fourier transform of the incident light beam by inducing a relative angle (hereinafter referred to as the tilt angle) between the wavefronts of the two polarized components of the output beam. With the Transform Device, this angle is linearly proportional to the angle of incidence. The output produced by the Transform Device is the Fourier transform itself rather than its square, as is the case for coherent Fourier transforms using a lens as the transform element. GRA

N92-14839# Department of the Navy, Washington, DC.
HIGH PRESSURE FIBER OPTIC CONNECTOR PLUG Patent Application
Gerald Holmberg, inventor (to Navy) and Roger Morency, inventor (to Navy) 7 Dec. 1990 18 p
(AD-D015033; US-Patent-Appl-SN-625720) Avail: NTIS HC/MF A03 CSCL 20/6

A fiber optic cable connection for high pressure environments utilizes a fiber optic cable having (1) a multiplicity of fiber optic strands extending axially therein, (2) a strength member extending axially in spaced relationship there about, (3) an outer jacket, and (4) a filler matrix within the strength member and in which the strands are encased. It is a precision connector with an inner face having an axially extending recess and with axially extending passages extending from the transverse wall of the recess to the outer face of the connector member and through which the fiber optic strands extend. A preload insert member is disposed about the strands with its outer end extending into the recess of the connector and a peripheral shoulder abutting the inner face of the connector member. The strength member of the cable has its outer end portion extending outwardly from the end of the jacket and onto the reduced diameter portion. A body member is disposed about the insert member and has its outer end extending over the inner end portion of the connector. GRA

N92-14840# International Centre for Theoretical Physics, Trieste (Italy).
THE TECHNIQUES OF OPTICAL FIBRE MEASUREMENTS: AN OVERALL DESCRIPTION
Zhenyuan Liu Nov. 1990 16 p
(DE91-635892; IC-90/358) Avail: NTIS HC/MF A03

Some advanced optical fiber measurement techniques are briefly described. They are used in measuring optical characteristics, geometrical characteristics, and optical transmission characteristics of optical fibers. The standard methods recommended by the Consultative Committee of International Telephone and Telegraph (CCITT) are the main topic of discussion. DOE

N92-14841# Los Alamos National Lab., NM.
SUPPORT OF THE NATO EFFECTS TASK GROUP BY LOS ALAMOS NATIONAL LABORATORY
P. B. Lyons 1991 41 p Presented at the 1991 Nuclear Effects Task Group (NETG) Annual Meeting, Munich (Germany), Sep. 1991
(Contract W-7405-eng-36)
(DE92-000251; LA-UR-91-2940; LA-UR-91-990; CONF-9109277-1) Avail: NTIS HC/MF A03

A method is outlined for measuring the transient attenuation of optical fibers and/or cables exposed to a pulse of radiation (gamma rays, x rays, electrons, protons, neutrons, etc). It can be employed to determine the level of radiation-induced attenuation (in units of dB/km as a function of time) produced in single-mode or multi-mode optical fibers, in either cabled or uncabled form, due to pulsed exposure to radiation. Co-60) radiation-induced attenuation is measured by optical time domain reflectometry (OTDR) techniques and compared to conventional optical throughput measurements. Relative advantages and disadvantages of the OTDR technique are discussed. DOE

N92-14842# Sandia National Labs., Albuquerque, NM.
INTERFERING OPTICAL INTERACTIONS: PHASE SENSITIVE ABSORPTION
Ce Chen, Yi-Yian Yin, D. S. Elliott (Purdue Univ., West Lafayette, IN.), and A. V. Smith 1991 14 p Presented at the NATO Advanced Research Workshop on Coherence Phenomena in Atoms and Molecules in Laser Fields, Toronto (Canada), Aug. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000795; SAND-91-2096C; CONF-9108170-1) Avail: NTIS HC/MF A03

Interference effects have been especially important in the development of new frontiers in physics. In this paper we will discuss a relatively new type of interference in laser-atom interactions, and our experimental studies of its properties, limitations, and applications. The interference which we have been studying is between different optical processes which can individually lead to the excitation of the same atomic or molecular state. This interference has been identified as the cause of the suppression of multiphoton excitation of various atomic species when the density of the nonlinear medium is relatively high. The experiments we will discuss here can be extended in many new directions, including studies of propagation effects in nonlinear optical media, control of reaction products in laser induced ionization or dissociation, or control of photoelectron angular distributions. DOE

N92-13980# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
FIBER OPTIC SMART STRUCTURES
R. M. Measures, K. Liu, W. E. R. Davies, K. F. McEwen, N. D. Glossop, D. Laurin, R. Turner, T. Valis, B. Blagojevic, and S. Ferguson et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 71-75 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

N92-14086*# Naval Observatory, Washington, DC. Orbital Mechanics Dept.
IMPROVED ACCURACIES FOR SATELLITE TRACKING
P. C. Kammeyer, A. D. Fiala, and P. K. Seidelmann *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 285-297 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 20F

N92-14773*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTONICS
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 37-53 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 20F

N92-14909*# Arizona Univ., Tucson. Optical Sciences Center.
DIFFERENTIAL SPOT-SIZE FOCUS SERVO
T. D. Milster, M. S. Wang, F. F. Froehlich, J. L. Kann, J. P. Treptau, and K. E. Erwin *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 175-180 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20F

N92-14915*# Arizona Univ., Tucson. Optical Sciences Center.
EFFECTS OF BEAM FOCUSING ON THE EFFICIENCY OF PLANAR WAVEGUIDE GRATING COUPLERS
Lifeng Li and Mool C. Gupta *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 223-228 Repr. from 5320 Applied Optics, v 29, no. 38, 20 Dec. 1990 Sponsored in part by DTRL/Kodak; and Arizona Univ., Tucson (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-14843# Nagoya Univ. (Japan). Plasma Science Center.
NEW NON-AXISYMMETRIC EIGENMODES ASSOCIATED WITH AN EDGE PLASMA LAYER
Kaoru Yamanaka (University of Industrial Technology, Kanagawa, Japan) and Ryo Sugihara Dec. 1989 24 p
(DE90-798727; PSC-5) Avail: NTIS (US Sales Only) HC A03

Effects of a rarefied plasma layer surrounding a cylindrical main plasma on Alfven waves are investigated. The plasma is approximated with a two-step density profile and is assumed to be surrounded with a conducting wall. When the Alfven resonance

exists inside the rarefied plasma layer, two new modes are generated. One has its maximum of the wave intensity at the wall, is thus similar to a surface wave and the other is a short of a coaxial mode. These results are re-examined in a diffuse boundary plasma and the presence of these modes is confirmed. DOE

N92-14844# National Inst. for Fusion Science, Nagoya (Japan).
CONCEPTUAL DESIGN OF D-He-3 FRC REACTOR ARTEMIS
H. Momota, A. Ishida, Y. Kohzaki, G. H. Miley, S. Ohi, M. Ohnishi, K. Yoshikawa, K. Sato, L. C. Steinhauer (Spectra Technology, Inc., Bellevue, WA.), and Y. Tomita et al Jul. 1991 45 p Sponsored by Ministry of Education, Science and Culture and DOE
(NIFS-101; ISSN-0915-633X) Avail: NTIS HC/MF A03

A comprehensive design study of the D-He-3 fueled Field Reversed Configuration (FRC) reactor ARTEMIS is carried out for the purpose of proving its attractive characteristics and clarifying the critical issues for a commercial fusion reactor. The FRC burning plasma is stabilized and sustained in a steady equilibrium by means of a preferential trapping of D-He-3 fusion-produced energetic protons. A novel direct energy converter for 15MeV protons is also presented. On the bases of a consistent scenario of the fusion plasma production and simple engineering, a compact and simple reactor concept is presented. The design of the D-He-3 FRC power plant definitely offers the most attractive prospect for energy development. It is environmentally acceptable in view of radioactivity and fuel resources; and the estimated cost of electricity is low compared to a light water reactor. Critical issues concerning physics or engineering for the development of the D-He-3 FRC reactor are clarified. Author

N92-14845# Texas Univ., Austin. Inst. for Fusion Studies.
ENHANCEMENT OF CURRENT DIFFUSION IN THE PRESENCE OF A KINK MODE OR AN ALFVEN WAVE
A. D. Beklemishev Aug. 1991 26 p
(Contract DE-FG05-80ET-53088)
(DE91-018424; DOE/ET-53088/517; IFSR-517) Avail: NTIS HC/MF A03

Many characteristic features of Alfven waves and related instabilities are strongly dependent on the inhomogeneity of the background density and the magnetic field. On the other hand, these waves also have an influence on the inhomogeneity, which is caused by the enhancement of the cross-field transport through wave distortion of flux surfaces. This problem is addressed here within the framework of the single-fluid reduced MHD model and generalized Lagrangian representation of motion. The new effect of transport enhancement is identified as a consequence of the local squeezing of adjacent flux surfaces, which results in increased radial gradients and cross-field fluxes. This effect is found to be proportional to the second power of the ratio of the magnetic field perturbation to the normal field component. The result is applied to several problems related to m = 1 equilibrium relaxation and Alfven resonance broadening. DOE

N92-14846*# Southwest Research Inst., San Antonio, TX.
A SIMULATION STUDY OF INTERACTIONS OF SPACE-SHUTTLE GENERATED ELECTRON BEAMS WITH AMBIENT PLASMA AND NEUTRAL GAS Annual Progress Report
Robert M. Winglee 14 Nov. 1991 26 p
(Grant NAGw-1936; SwRI Proj. 15-3399)
(NASA-CR-189019; NAS 1.26:189019) Avail: NTIS HC/MF A03 CSCL 20I

The objective was to conduct large scale simulations of electron beams injected into space. The study of the active injection of electron beams from spacecraft is important, as it provides valuable insight into the plasma beam interactions and the development of current systems in the ionosphere. However, the beam injection itself is not simple, being constrained by the ability of the spacecraft to draw current from the ambient plasma. The generation of these return currents is dependent on several factors, including the density of the ambient plasma relative to the beam density, the presence of neutrals around the spacecraft, the configuration of the spacecraft, and the motion of the spacecraft through the plasma. Two dimensional (three velocity) particle simulations with collisional processes included are used to show how these different and often coupled processes can be used to enhance beam propagation from the spacecraft. To understand the radial expansion mechanism of an electron beam injected from a highly charged spacecraft, two dimensional particle-in-cell simulations were conducted for a high density electron beam injected parallel to magnetic fields from an isolated equipotential conductor into a cold background plasma. The simulations indicate that charge build-up at the beam stagnation point causes the beam to expand radially to the beam electron gyroradius. Author

N92-14847# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
SIMULATION OF STEADY CURRENT MAINTAINING IN A TOKAMAK THERMONUCLEAR REACTOR WITH NEUTRAL ATOM BEAM INJECTION
V. M. Leonov and A. R. Polevoj 1990 32 p In RUSSIAN; ENGLISH summary
(DE91-636815; IAE-5013-8) Avail: NTIS HC/MF A03

The results of numerical simulation of maintaining stationary current using neutral injection in the tokamak fusion reactor are presented. The calculation of the method efficiency and of the necessary rate of injection depending on the plasma parameters and the injection system are presented. Various methods for changing the profile of the generated current are studied. DOE

N92-14848# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
CURRENT GENERATION BY NEUTRAL BEAM INJECTION IN A NON-CIRCULAR TOKAMAK
V. M. Leonov, S. E. Lysenko, F. S. Zajtsev, A. P. Smirnov, and A. A. Chernov 1990 20 p In RUSSIAN; ENGLISH summary
(DE91-636816; IAE-5028-7) Avail: NTIS HC/MF A03

A numerical model of the injected particle source, taking into account for drift motion of produced ions in tokamaks with noncircular flux vertical cross-section of magnetic surfaces is described. The expressions for calculation of neutral beam current drive (NBCD) effectiveness are derived from the analytical solution of the Fokker-Planck equation. The effectiveness of NBCD in tokamak reactor ITER is estimated. DOE

N92-14849# Academy of Sciences (USSR), Moscow. Nauchno-Issledovatelskij Inst. Yadernoj Fiziki.
IONIC COMPOSITION OF PLASMA AND ENERGETIC PARTICLES IN THE NEAR-EARTH COSMIC SPACE
M. I. Panasyuk and A. S. Kovtyukh 1990 50 p In RUSSIAN
(DE91-638486; NIIYAF-MGU-90-6-152) Avail: NTIS HC/MF A03

An analytic review of experimental results of the recent years related to mass, energy and charge composition of plasma and energetic particles in the near space according to the data of the Gorizont, Prognoz-7, AMPTE/CCE, AMPTE/IRM, Dynamic Explorer satellites is presented. Comparison to the existing theoretical models is presented. It is shown that both solar wind and the Earth ionosphere serve as a source of hot plasma. DOE

N92-14850# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
PROPOSED RESEARCH ON ADVANCED ACCELERATOR CONCEPTS
R. C. Davidson and J. S. Wurtele Sep. 1991 11 p
(Contract DE-FG02-88ER-40465)
(DE92-000824; DOE/ER-40465/T2) Avail: NTIS HC/MF A03

This report summarizes technical progress and accomplishments during the proposed three-year research on advanced accelerator concepts supported by the Department of Energy under Contract No. DE-FG02-88ER-40465. A vigorous theoretical program has been pursued in critical problem areas related to advanced accelerator concepts and the basic equilibrium, stability, and radiation properties of intense charged particle beams. Broadly speaking, our research has made significant contributions

in the following three major areas: Investigations of physics issues related to particle acceleration including two-beam accelerators and cyclotron resonance laser (CRL) accelerators; Investigations of RF sources including the free-electron lasers, cyclotron resonance masers, and relativistic magnetrons; Studies of coherent structures in electron plasmas and beams ranging from a low-density, nonrelativistic, pure electron plasma column to high-density, relativistic, non-neutral electron flow in a high-voltage diode. The remainder of this report presents theoretical and computational advances in these areas. DOE

N92-14851# International Atomic Energy Agency, Vienna (Austria).
ITER DIAGNOSTICS
V. Mukhovatov, H. Hopman, and S. Yamamoto Feb. 1991 130 p
(DE91-626549; INIS-mf-12802) Avail: NTIS HC/MF A07

As part of the International Thermonuclear Experimental Reactor (ITER) Conceptual Design Activity (CDA), three workshops were held on plasma diagnostics. From these conferences, a set of diagnostics for the full operation of ITER has been developed. This report summarizes the results of these design and discussion activities, and the incorporation of the concepts developed into the overall ITER experiment. DOE

N92-14852# International Atomic Energy Agency, Vienna (Austria).
TWIN LOOPS FOR VERTICAL CONTROL OF HIGHLY ELONGATED PLASMA
Yu. Gribov, J. Leuer, S. Nishio, and S. Sadakov Feb. 1991 26 p
(DE91-626554; INIS-mf-12799) Avail: NTIS HC/MF A03

The plasma shape in the proposed International Thermonuclear Experimental Reactor (ITER) tokamak will be highly elongated, necessitating stabilization of the vertical instability. A method of passive stabilization using twin loops has been examined as part of the ITER Conceptual Design Activities. Results are given in this report. Comparison with the saddle loop concept details the advantages of the twin loops. DOE

N92-14853# International Atomic Energy Agency, Vienna (Austria).
ITER CONCEPTUAL DESIGN ACTIVITIES Final Report
Feb. 1991 20 p
(DE91-626576; INIS-mf-12800) Avail: NTIS HC/MF A03

The final report of the International Thermonuclear Experimental Reactor (ITER) Conceptual Design Activities has been prepared by the ITER Council. Statements of the ITER objective, subject matter and organization of the Conceptual Design Activities, concept description, design and R and D activities, future R and D activities and needs, safety and environmental analysis and site requirements, and additional benefits of ITER are summarized, and conclusions are given. DOE

N92-14854# China Nuclear Information Centre, Beijing.
DEVELOPMENT OF PLASMA CURRENT WAVEFORM ADJUSTING SYSTEM ZLJ FOR TOKAMAK DEVICE HL-1
Shangbing Wang, Haotian Hu, Fangqun Tang, Yongzheng Zhou, Xiuzhong Chu, Jiashun Cheng, and Yunxia Gao Dec. 1989 7 p
(DE91-628424; CNIC-00382; SIP-0040) Avail: NTIS HC/MF A02

The control of some typical Tokamak discharge waveforms has been achieved by using the plasma current waveform adjusting system ZLJ in the ohmic heating of HL-1. The discharge waveforms include a series of regular plasma current waveforms with various slow rising rates, such as 80 kA, 450 ms long flat-topping; 100 kA, 200 ms rising; 200 ms falt-topping and 180 kA, 400 ms slow rising etc. The design principle of the system and the initial experimental results are described. DOE

N92-14855# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
CHARACTERISTICS OF A PLASMA PRODUCED BY MAGNETIC STRAIGHT DISCHARGE IN THE METAL CHAMBER AT THE SPIN DEVICE
B. A. Knyazev, P. I. Melnikov, and V. V. Chikunov 1990 16 p In RUSSIAN; ENGLISH summary
(DE91-636499; IYaF-90-39) Avail: NTIS HC/MF A03

A helium plasma at 1 m length and 6 cm diameter was produced by a pulse discharge between two foils in the stainless steel tube of 10 cm diameter in the mirror trap. The plasma is intended to use in the experiments on high-power microsecond REB transport and for studying the beam-plasma interaction. The time dependences of plasma density and temperature and density spatial distribution was examined for initial gas density from 3x10(exp 14) to 2x10(exp 16)cm(exp -3). DOE

N92-14856# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
INTERACTION OF THE HIGH-POWER MICROSECOND REB WITH GAS AND PLASMA IN A 1-m SOLENOID
B. A. Knyazev, P. I. Melnikov, and V. V. Chikunov 1990 19 p In RUSSIAN; ENGLISH summary
(DE91-636500; IYaF-90-40) Avail: NTIS HC/MF A03

We have investigated the propagation of an intense microsecond relativistic electron beam (REB) through an initially neutral gas or through a preformed plasma in a longitudinal magnetic field at the U1-SPIN device. The e-beam is generated in a plane diode and, after passing through the anode foil, is adiabatically compressed in the converging magnetic field and is injected through a thin foil into a stainless steel drift tube. The tube is placed in a uniform magnetic field with the magnetic mirrors at the solenoid ends. The beam current density in the tube runs into 2 kA/sq cm. The tube is prefilled with gas or He plasma. The diagnostics are described in the paper. When the gas density n(sub 0) is more than 2 x 10 exp 15/cc, the ionization of the beam results in the creation of a plasma, which is heated by the return current up to 3-20 eV to the pulse end. The beam is transported along the magnetic field lines and its cross-section remains macroscopically uniform. When the gas pressure is low, the high space charge potential of the beam at the pulse-start induces breakdown along the tube surface. The produced plasma neutralizes the beam space charge and partially reduces the beam current. At the end of the pulse, a dense plasma with a high energy content is produced. In this case, the beam cross-section at the exit of the drift tube is distorted. When the beam is injected in a neutral helium or a helium plasma at a density of approximately 10 exp 15/cc, we have a plasma with n sub e = 2n(sub 0) and with an average transverse energy of about 300-400 eV/electron as a result of beam-plasma interaction. The hot electron population with a characteristic energy of approximately 20 keV was observed. DOE

N92-14857# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
DETERMINATION OF PLASMA DENSITY AND ION TEMPERATURE USING HYDROGEN RADIATION SPECTRAL MEASUREMENTS IN A GAS-DYNAMIC TRAP
A. N. Zinovev, E. R. Krzhizhanovskij, A. A. Ivanoc, and V. V. Klesov 1990 23 p In RUSSIAN; ENGLISH summary
(DE91-636586; IYaF-90-20) Avail: NTIS HC/MF A03

A diagnostics complex for measurement of plasma parameters in a gas-dynamic trap (GDT) using hydrogen radiation lines is described. Physical bases of the diagnostics method for ion temperature determination are presented; recording equipment is described. The results of measurements at GDT installation under plasma heating conditions using atomic beam injection are discussed. The method for measuring spatial distribution of plasma density in the cross section of a plasma filament is suggested; the results of preliminary experiments showing principle possibility of its realization are presented. DOE

N92-14858# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
SUPPRESSION OF THE KELVIN-HELMHOLTZ INSTABILITY BY PLASMA JET ELECTRIC FIELD REVERSAL
A. A. Kabantsev 1989 12 p In RUSSIAN
(DE91-636636; IYAF-89-164) Avail: NTIS HC/MF A03

The concrete physical mechanism of development of the Kelvin-Helmholtz low-frequency (omega similar to 2 x 10(sup 5)/s much less than omega(sub ci)) instability caused by considerable inhomogeneity of the radial profile of angular velocity omega(sub E)(r) of the plasma electric drift in crossed fields is considered. As follows from the consideration, the character of omega(sub E)(r) inhomogeneity influence on plasma jet stability is determined by the sign of (dn/dr) x ((d x omega sub E)/dr)(n is plasma density). It permits suppression of the development of the Kelvin-Helmholtz instability, observed in the plasma jet of a ring gas-discharge source, by reversing the obtained electric data.
DOE

N92-14859# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
NUMERICAL ANALYSIS OF DISPERSION EQUATION FOR ELECTROSTATIC OSCILLATIONS OF ION-ION PLASMA IN STRONG MAGNETIC FIELD [CHISLENNYL ANALIZ DISPERSIONNOGO URAVNENIYA EHIEKTROSTATICHESKIKH KOLEBANIJ ION-LONNOJ PLAZMY V SILNOM MAGNITNOM POLE]
V. E. Dyakov, V. V. Olshanskij, and V. I. Panchenko 1989 10 p In RUSSIAN
(DE91-623737; KFTI-89-10) Avail: NTIS HC/MF A02

Consideration is given to results of numerical investigation of the linear stage of ion-ion instability of plasma located in strong homogeneous and stationary magnetic field conditioned by relative movement of ion components transverse to magnetic field. Dependences of critical relative velocity of ion components increment of oscillation, growth and dimensions of instability region in wave number space in wide ranges of changes of parameters, namely the ratios of temperatures for two types of ions T sub 01/T sub 02 and their concentrations n sub 1/n sub 2 are presented (T sub 01/T sub 02 = 0.1 to 10, n sub 1/n sub 2 = 0.1 to 10).
DOE

N92-14860# International Atomic Energy Agency, Vienna (Austria).
PHYSICS AND TECHNOLOGY R AND D FOR ITER CONCEPTUAL DESIGN. PART A: PHYSICS, PART B: TECHNOLOGY
J. Doggett Apr. 1991 160 p
(DE91-640899; INIS-mf-12894) Avail: NTIS HC/MF A08

As a part of the International Thermonuclear Experimental Reactor (ITER) Conceptual Design Activities, a list of tasks concerning questions which needed to be addressed was set up. These tasks covered areas of research which was needed as an augmentation to the existing fusion knowledge base. The results of the investigations involving these 23 tasks are reported in this document.
DOE

N92-14861# International Atomic Energy Agency, Vienna (Austria).
ITER PARAMETRIC ANALYSIS AND OPERATIONAL PERFORMANCE
L. J. Perkins, W. R. Spears, and J. D. Galambos Apr. 1991 99 p
(DE91-640901; INIS-mf-12896) Avail: NTIS HC/MF A05

One of the key components of the International Thermonuclear Experimental Reactor (ITER) Conceptual Design Activities (CDA) is the determination of optimum design, investigation of operation in various modes, recommendation of baseline performance specifications, studies of sensitivity of ITER design to uncertainties in physics, investigation of operational flexibility, assessment of alternative designs, and determination of implications for extrapolation to prospective DEMO reactors. These terms of reference are reported in this document.
DOE

N92-14862# Mississippi State Univ., Mississippi State. Diagnostic Instrumentation and Analysis Lab.
MODERN ENERGY TECHNOLOGIES NEED MODERN DIAGNOSTICS: MHD, A CASE STUDY
R. A. Kumar and R. L. Cook 1991 10 p Presented at the 26th Intersociety Energy Conversion Engineering (IECE) Conference, Boston, MA, 3-9 Aug. 1991
(Contract DE-AC02-80ET-15601)
(DE92-000634; CONF-910801-24) Avail: NTIS HC/MF A02

Optical based measurement systems provide an ideal basis to characterize and optimize advanced energy processes. This is especially true in the hostile environments of magnetohydrodynamic (MHD) flows where high pressures, temperatures and particle loadings are encountered. Most advanced energy processes, such as MHD, are integrations of energy rejection and extraction components which have to be carefully monitored and controlled. It can be shown that with a combination of optical techniques, i.e., the measurements of gas temperature, potassium atom densities and gas velocities, the main parameters that determine MHD channel power can be monitored. Downstream sections of an MHD power plant can be monitored by a combination of optical and probe based techniques to measure gas and wall temperatures as well as particle size formations. These parameters influence the performance of heat exchangers, seed regeneration and particulate cleaning equipment. The Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi state University has developed, and is continuing to develop, advanced optical diagnostic techniques for such applications. Most of the diagnostic techniques described here are general purpose and have applications and use beyond MHD.
DOE

N92-14863# Sandia National Labs., Albuquerque, NM.
ELECTRICAL CHARACTERIZATION OF RF PLASMAS
P. A. Miller 1 Aug. 1991 9 p Presented at the SPIE Meeting on Advanced Techniques for Integrated Circuit Processing, San Jose, CA, Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-000822; SAND-91-1824C; CONF-9110234-1) Avail: NTIS HC/MF A02

Radio-frequency (RF) electrical sources are commonly used to generate plasmas for processing of industrial materials and for related experimental work. Published descriptions of such plasmas usually include generator-power measurements, and occasionally include plasma dc-bias measurements. One or both of these quantitites are also used in industrial feedback control systems for setpoint regulation. Recent work at Sandia and elsewhere with an experimental RF discharge device (the GEC RF Reference Cell) has shown that for power and dc-bias levels is often insufficient information for specifying the state of the plasma. The plasma can have nonlinear electrical characteristics that cause harmonic generation, and the harmonic levels can depend sensitively on the impedance of the external circuitry at harmonic frequencies. Even though the harmonics may be low in amplitude, they can be directly related to large changes in plasma power and to changes in optical emission from the plasma. Consequently, in order for a worker to truly master the plasma-generation process, it is necessary to understand, measure, and control electrical characteristics of the plamsa. In this paper we describe techniques that have been developed from work with the Reference Cell for making electrical measurements on RF plasmas, and we describe surprising observations of harmonic behavior.
DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-14864# Sandia National Labs., Albuquerque, NM.
TRIGGERING GaAs LOCK-ON SWITCHES WITH LASER DIODE ARRAYS
G. M. Loubriel, W. D. Helgeson, D. L. McLaughlin, M. W. OMalley,

F. J. Zutavern, A. Rosen, and P. J. Stabile 1990 5 p Presented at the 19th Power Modulator Symposium, San Diego, CA, Jun. 1990
(Contracts DE-AC04-76DP-00789; DE-AC03-87SF-17127)
(DE90-013400; SAND-90-0157C; CONF-9006176-9) Avail: NTIS HC/MF A01

Many of the applications that require the unique capabilities of Photoconductive Semiconductor Switches (PCSS) demand a compact package. We have been able to demonstrate that GaAs switches operated in the high gain mode called lock-on meet the required electrical switching parameters of several such applications using small switch sizes. The only light source that has enough power to trigger a PCSS and is compatible with a small package is a laser diode. This paper will describe the progress that leads to the triggering of high power PCSS switches with laser diodes. Our goal is to switch up to 5 kA in a single shot mode and up to 100 MW repetitively at up to 10 kHz. These goals are feasible since the switches can be used in parallel or in series. Low light level triggering became possible after the discovery of a high electric field, high gain switching mode in GaAs (and later in InP). At electric fields below 3 kV/cm GaAs switches are activated by creation of, at most, only one conduction electron-valence hole pair per photon absorbed in the sample. This linear mode demands high laser power and, after the light is extinguished, the carriers live for only a few nanoseconds. At higher electric fields GaAs behaves as a light activated Zener diode. The laser light generates carriers as in the linear mode and the field induces gain such that the amount of light required to trigger the switch is reduced by a factor of up to 500. The gain continues until the field across the sample drops to a material dependent lock-on field. At this point the switch will carry as much current as, and for as long as, the circuit can maintain the lock-on field. The gain in the switch allows for the use of laser diodes.
DOE

N92-14865# Nebraska Univ., Lincoln. Center for Electro-Optics.
FIRST PRINCIPLES THEORETICAL STUDIES OF FERROELECTRIC LATTICE INSTABILITIES Annual Report, 1 Feb. - 30 Sep. 1991
J. R. Hardy 30 Sep. 1991 7 p
(Contract N00014-91-J-1531)
(AD-A241185) Avail: NTIS HC/MF A02 CSCL 20/5

Preliminary work on the theoretical understanding of polar (ferroelectric) lattice instabilities in ceramic oxides is described. Emphasis is placed on the need to handle electronic charge density redistribution and its effects on lattice instabilities. The emphasis is on doing so with a few variables as possible in order to make molecular dynamics studies of phase stability and other properties possible. In addition, a summary is presented of work carried out to round out studies under our previous ONR Award. The objective of this new program can be stated very simply; it is to incorporate the effects of electronic charge redistribution into a calculations of changes in lattice potential energies for arbitrary crystal distortion and thus to predict its influence on the uniform polar (antiphase motion of positive and negative ions) distortions associated with ferroelectricty in oxide based ferroelectrics. Our belief that this is central to the understanding of ferroelectric behavior in these, the overwhelming majority of such materials, is based on earlier studies during the previous program.
GRA

N92-14866# California Univ., Berkeley. Lawrence Berkeley Lab.
CRYSTAL STRUCTURE OF STAGE 1 IODINE INTERCALATED SUPERCONDUCTING IBi2Sr2CaCu2O(x)
N. Kijima, R. Gronsky, X. Xiang, W. Vareka, A. Zettl, J. Corkill, and M. Cohen Jul. 1991 24 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000849; LBL-30948; CONF-911202-1) Avail: NTIS HC/MF A03

The crystal structure of stage-1 iodine intercalated superconducting IBi2Sr2CaCu2O(x) has been determined by transmission electron microscopy to belong to the superspace group C(sub (anti 1)1)(sub (anti 1))(sup Pma2) with subcell lattice parameters a = 5.4A, b = 5.4A, c = 18.8A, and a structural modulation wavelength of 26A. Intercalated iodine atoms alter the atomic stacking across Bi-O layers from the staggered configuration characteristic of superconducting Bi2Sr2CaCu2O(x) to a vertically aligned configuration in IBi2Sr2CaCu2O(x). From the atomic spacings apparent in the images, it is concluded that the iodine layers bond to their neighboring Bi-O layers by van der Waals interactions.
DOE

N92-14867# California Univ., Berkeley. Lawrence Berkeley Lab.
NON-STOICHIOMETRIC DEFECTS IN YBaCuO THIN FILMS
M. Fendorf, M. Tidjani, C. P. Burmester, R. Gronsky, and L. T. Wille (Florida Atlantic Univ., Boca Raton.) Apr. 1991 6 p Presented at the International Conference on Advanced Materials (ICAM 91), Strasbourg (France), 27-31 May 1991
(Contract DE-AC03-76SF-00098)
(DE92-000954; LBL-30928; CONF-910580-5) Avail: NTIS HC/MF A02

Defects in superconducting YBaCuO thin films deposited by laser ablation are investigated by high resolution transmission electron microscopy. Micrographs reveal numerous defects in the YBaCuO film, falling into four basic classes. One of these is an interesting, non-stoichiometric helical defect structure which possibly corresponds to a growth-related screw dislocation. In general, defects in the YBaCuO film are associated both with growth geometry and with local deviations in stoichiometry. Substrate surface geometry is seen to have a profound effect on the number and type of defects produced. Simulation of annealing transformations using a static lattice, three dimensional, Monte Carlo technique is carried out to gain further insight into specific defect formation mechanisms. The results of these studies suggest preparation conditions that are expected to lead to films with improved critical current densities.
DOE

N92-14868# Minas Gerais Univ., Belo Horizonte (Brazil).
PLOTTER OF POLE FIGURE USING DATA FROM X RAY DIFFRACTION M.S. Thesis
A. F. Lima 1990 77 p In PORTUGUESE; ENGLISH summary
(DE91-634207; INIS-BR-2452) Avail: NTIS HC/MF A05

Any polycrystalline aggregate normally has a preferred crystallographic orientation, or texture which depends on its thermal and or mechanical history. Preferred orientation is best described by means of a pole figure. A pole figure is a stereographic projection which shows the variation in pole density with pole orientation, for a selected set of crystal planes. In this work, computer programs was developed to plot pole figures. The corrected intensities are calculated and directly transmitted to the plotter. The different intensities levels are represented by different colors in the pole fi
DOE

N92-14869# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Lab. of Neutron Physics.
INFLUENCE OF THE SUPERCONDUCTING ENERGY GAP ON THE LINE WIDTH OF THE CRYSTAL FIELD TRANSITION IN THE HIGH Tc SUPERCONDUCTOR Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
E. A. Goremychkin, R. Osborn, and A. D. Taylor (Rutherford Appleton Lab., Chilton, England) 1989 4 p
(DE91-636317; JINR-E-14-89-721) Avail: NTIS HC/MF A01

By inelastic neutron scattering the temperature dependence of the line width of transitions between crystal field levels were measured in the high T(sub c) superconductor Tm(0.1)-Y(0.9)Ba2Cu3O(6.9). At T less than T(sub c) the decreasing of the line width due to the opening of the superconducting energy gap was observed. The coupling constant rho' which characterizes the strength of an s-f interactions was estimated to be rho' = 0.025 +/- 0.005.
DOE

N92-14870# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INELASTIC NEUTRON SCATTERING IN THE ANHARMONIC MODEL OF HIGH-Tc SUPERCONDUCTORS
N. M. Plakida, V. L. Aksenov, S. L. Drechsler, T. Galbaatar, and S. Stamenkovic 1989 7 p Submitted for publication
(DE91-636318; JINR-E-17-89-670) Avail: NTIS HC/MF A02

The inelastic neutron scattering on highly anharmonic vibrations of oxygen ions in high-T(sub c) superconductors is studied in the framework of a pseudo-spin model. By evaluating the coherent and incoherent cross-sections, it turned out that the scattering intensity exhibits an anomalous temperature dependence. DOE

N92-14871# Ceskoslovenska Vedeckotechnicka Spolecnost, Prague. Dum Techniky.
INTERNATIONAL CONFERENCE ON ADVANCED METHODS IN X RAY AND NEUTRON STRUCTURE ANALYSIS OF MATERIALS Abstracts Only
1990 192 p Conference held in Prague, Czechoslovakia, 20-24 Aug. 1990
(DE91-639071; INIS-mf-12886; CONF-9008114) Avail: NTIS HC/MF A09

The publication contains abstracts of 186 contributions presented at the international conference in the oral or poster form. Attention was paid particularly to crystal and molecular structures, diffraction analysis of physical phenomena, and to powder diffraction and real structures. DOE

N92-14872# California Univ., Berkeley. Lawrence Berkeley Lab.
MICROSCOPIC DETERMINATION OF STRESS DISTRIBUTION IN GaAs GROWN AT LOW TEMPERATURE ON GaAs (100)
Z. Liliental-Weber, M. Tanaka, A. Ishikawa, and M. Teriauchi (Tohoku Univ., Sendai, Japan) Jan. 1991 7 p Presented at the Fall Meeting of the Materials Research Society (MRS), Boston, MA, 24 Nov. - 1 Dec. 1990
(DE92-000868; LBL-30112; CONF-901105-129) Avail: NTIS HC/MF A02

A microscopic strain distribution across commensurate interfaces between GaAs layers grown on semi-insulating GaAs substrates was observed by means of convergent beam electron diffraction (CBED) and large angle convergent beam methods (LACBED). Strain relaxation at a specific distance from the interface was observed in these layers without formation of misfit dislocations. It was proposed that specific point defects distributed close to the interface can explain the asymmetric broadening of high-order Laue zone (HOLZ) lines in the CBED patterns. DOE

N92-14873# California Univ., Berkeley. Lawrence Berkeley Lab.
THEORETICAL MODELING AND EXPERIMENTAL CHARACTERIZATION OF PLANAR DEFECTS IN Y2Ba4Cu(6+x)O(14+x)
C. P. Burmester, M. Fendorf, R. Gronsky, and L. T. Wille (Florida Atlantic Univ., Boca Raton.) Nov. 1990 7 p Presented at the Fall Meeting of the Materials Research Society (MRS), Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000898; LBL-29284; CONF-901105-130) Avail: NTIS HC/MF A02

Crystallographic defects and phase transformations in the system Y2Ba4Cu(6+x)O(14+x)(0 less than or equal to x less than or equal to 4) are investigated by high resolution transmission electron microscopy (TEM) and static lattice, three dimensional Monte Carlo computer simulations. High resolution images of partially transformed (x equals 2 to x equals 1) material reveal a prevalence of CuO planar defects (stacking faults) associated with the transformation and an absence of disturbance to the perovskite Ba-Y-Ba blocks. An atomic mechanism involving the intercalculation and removal of extra CuO planes by partial dislocation climb, and requiring only a-b plane diffusion, is developed for the formation of such planar defects during changes in the layered YBaCuO crystal structure. Monte Carlo simulations based on the proposed transformation mechanism accurately reproduce the observed defects and known equilibrium structures. DOE

N92-14874# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
ANISOTROPY OF RELATIVISTIC LEPTON COHERENT SCATTERING AT AXIAL CHANNELING
V. I. Telegin, A. M. Kanloev, and F. R. Kungurov 1989 5 p In RUSSIAN; ENGLISH summary
(DE91-623659; IAE-4944-1) Avail: NTIS HC/MF A01

The contribution of the coherent and incoherent scattering of relativistic leptons passed through thin crystals in the channeling mode to their angular distribution is considered. The investigation was carried out by numerical integration of the motion equations for a great number of particles. It is shown that in the crystals with a thickness smaller than the dechanneling length, the determining role in formation of distribution over the axit angles is played by the coherent scattering of particles by atomic chains. The effect of the multiple scattering on the angular distribution is negligibly small. DOE

N92-14875# Cornell Univ., Ithaca, NY.
DEFECT STUDIES IN 3-5 THIN FILM SEMICONDUCTORS
1991 26 p
(Contract DE-FG02-86ER-45278)
(DE92-000052; DOE/ER-45278/5) Avail: NTIS HC/MF A03

Our primary research objective in 1990-91 has been to continue studying misfit dislocation confinement by patterning substrates into mesas before the epitaxial growth of strained layers. This report presents progress for many of the areas of our research. DOE

N92-14876# California Univ., Berkeley. Lawrence Berkeley Lab.
VERTICAL BRIDGMAN AND GRADIENT FREEZE GROWTH OF 3-5 COMPOUND SEMICONDUCTORS
E. D. Bourret Jul. 1990 10 p Presented at the Fall Meeting of the Materials Research Society (MRS), Boston, MA, 24 Nov. - 1 Dec. 1990
(Contract DE-AC03-76SF-00098)
(DE92-000893; LBL-28974; CONF-901105-129) Avail: NTIS HC/MF A02

Major improvements in the structural and electrical perfection of single crystals of III-V compound semiconductors have been achieved by using new vertical Bridgman-type and vertical gradient freeze techniques. A general review of experimental set-ups used for growth of large diameter crystals of GaP, InP and GaAs is presented. Crystal properties and characteristic features are discussed to illustrate advantages and disadvantages of the vertical Bridgman-type growth techniques. DOE

N92-14877# Institut National des Sciences Appliquees, Lyon (France). Genie Electrique et Ferroelectricite.
CHARACTERIZATION OF PIEZOELECTRIC MATERIALS: MODELING OF LOSSES AT GRAIN BOUNDARIES AND AT DOMAIN WALLS Ph.D. Thesis [CARACTERISATION DES MATERIAUX PIEZOELECTRIQUES: MODELISATION DES PERTES AUX JOINTS DE GRAINS ET AUX PAROIS DE DOMAINES]
Roland Briot 1991 271 p In FRENCH
(ISAL-91-0014; ETN-92-90459) Avail: NTIS HC/MF A12

A new model which describes the evolution of the conductance and of dielectric and mechanical losses for piezoelectric ceramics with regard to frequency is defined. The motion of domain walls in the polycrystalline specimens is considered. This model allows for the specification of the influence of grain, grain boundaries, and domain walls on elastic losses of piezoelectric ceramics. The model is also used for the characterization of materials of identical basic composition, but with growing manganese content. It was shown that a low content of manganese improved grain and grain boundary characteristics, but that excess of manganese deteriorates intrinsic grain properties. The proposed model allows

a better understanding of the origin of losses in materials, and of the influence of substitute elements in the electromechanical properties of piezoceramics. ESA

N92-13944*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
OPTIMAL DESIGN OF SOLIDIFICATION PROCESSES
Jonathan A. Dantzig and Daniel A. Tortorelli *In* Pennsylvania State Univ., Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3) 1991 p 213-225 (For primary document see N92-13928 05-01)
(Grants NAGw-1683; NAG3-1286)
Avail: NTIS HC/MF A99 CSCL 20L

N92-14772*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SOLID STATE DEVICES
In its Center for Space Microelectronics Technology 15 Jul. 1991 p 7-33 (For primary document see N92-14771 05-70)
Avail: NTIS HC/MF A05 CSCL 20L

N92-14903*# Arizona Univ., Tucson. Optical Sciences Center.
CHARACTERIZATION OF MAGNETO-OPTICAL MEDIA
Roger A. Hajjar, Te-ho Wu, and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 53-69 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

N92-14906*# Arizona Univ., Tucson. Optical Sciences Center.
COERCIVITY OF DOMAIN WALL MOTION IN THIN FILMS OF AMORPHOUS RARE EARTH-TRANSITION METAL ALLOYS
M. Mansuripur, R. C. Giles, and G. Patterson (Boston Univ., MA.) *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 95-108 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

N92-14907*# Arizona Univ., Tucson. Optical Sciences Center.
EFFECT OF PATCH BORDERS ON COERCIVITY IN AMORPHOUS RARE EARTH-TRANSITION METAL THIN FILMS
G. Patterson (Boston Univ., MA.), H. Fu, R. C. Giles, and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 109-118 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-14878# Stanford Linear Accelerator Center, CA.
DISCRETE ANTI-GRAVITY
H. Pierre Noyes and Scott Starson (Starson Corp., Toronto, Ontario) Mar. 1991 16 p Presented at the 7th Alternative Natural Philosophy Association (ANPA) West Meeting, Stanford, 16-18 Feb. 1991
(Contract DE-AC03-76SF-00515)
(DE91-011756; SU-SLAC-PUB-5429; CONF-9102114-Abst)
Avail: NTIS HC/MF A03

Discrete physics, because it replaces time evolution generated by the energy operator with a global bit-string generator (program universe) and replaces fields with the relativistic Wheeler-Feynman action at a distance, allows the consistent formulation of the concept of signed gravitational charge for massive particles. The resulting prediction made by this version of the theory is that free anti-particles near the surface of the earth will fall up with the same acceleration that the corresponding particles fall down. So far as we can see, no current experimental information is in conflict with this prediction of our theory. The experiment crusis will be one of the anti-proton or anti-hydrogen experiments at CERN. Our prediction should be much easier to test than the small effects which those experiments are currently designed to detect or bound. DOE

N92-14879# Ames Lab., IA.
STRUCTURES AND THERMODYNAMICS OF SOME RARE EARTH SULFIDES Ph.D. Thesis
Yan Zhang Sep. 1991 117 p
(Contract W-7405-eng-82)
(DE91-018554; IS-T-1504) Avail: NTIS HC/MF A06

The vaporization behavior of the Nd-S and Yb-S systems was studied at 1952 - 2229 K and 1688 - 1842 K respectively. The congruent vaporizing compounds found in both systems are nonstoichiometric compounds, i.e., NdS(1.38) and Yb(0.877)S. The equilibrium partial pressures of the gaseous species, the second- and third-law enthalpies and entropies of the vaporization reaction were obtained. Two new thulium sulfides: Tm8S11 and Tm15S22 were discovered by vaporization of Tm-S samples using the Knudsen effusion method. Single crystals of both compounds were obtained and their structures were solved by single crystal x-ray diffraction techniques. DOE

N92-14880# International Centre for Theoretical Physics, Trieste (Italy).
ON TOPOLOGICAL SYMMETRIES AND THE GOLDSTONE THEOREM
Y. Shamir and S. H. Park Nov. 1990 9 p
(DE91-634058; IC-90/406) Avail: NTIS HC/MF A02

We show that one cannot achieve the symmetry breaking condition the limit as R approaches infinity of (Q sub r, omega) not = 0 when Q(sub R) is the (finite volume) integral of a topological charge density and omega has a compact support. This implies that topological symmetries are never broken spontaneously. If one attempts to use an operator omega prime whose support extends to spatial infinity as an order parameter the resulting symmetry breaking condition can be formally satisfied, but the Goldstone Theorem does not apply because, in general, the topological charge is no longer conserved. This (wrong) symmetry breaking condition need not contain any dynamical information and merely reflects the effect of omega prime on the boundary conditions at spatial infinity. DOE

N92-14881# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj Fiziki.
TWO-LOOP FREE ENERGY FOR FINITE TEMPERATURE SU(2) GAUGE THEORY IN A CONSTANT EXTERNAL FIELD
V. M. Belyaev and V. L. Eletskij 1989 18 p
(DE91-628109; ITEP-68-89) Avail: NTIS HC/MF A03

A two-loop euclidean calculation of the free energy for finite temperature SU(2) gauge theory in the background field A(sub 0) equals const is carried out using background Feynman gauge. Thus, at the two loop level the SU(2) symmetry is broken to U(1). Higher order perturbative effects are briefly discussed. DOE

N92-14882# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj Fiziki.
1/N-EXPANSION IN QUANTUM MECHANICS, PART 1
V. S. Popov, V. D. Mur, and A. V. Sergeev 1989 30 p In RUSSIAN
(DE91-635986; ITEF-113-89) Avail: NTIS HC/MF A03

Applications of 1/N-expansion to calculation of energies and wave functions (including ones for quasistationary states), to the problem of two Coulomb centers and to the three-body problem are considered. It is shown that in many cases (for example, for exponential potentials and cc-bar charmonium states) this method provides high accuracy even for small quantum numbers, including

the ground state. Relationship of the results with properties of coherent states and minimizing the uncertainty ratios are discussed. DOE

N92-14883# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimentalnoj Fiziki.
1/N-EXPANSION IN QUANTUM MECHANICS, PART 2
V. S. Popov, V. D. Mur, and A. V. Sergeev 1989 44 p In RUSSIAN
(DE91-635987; ITEF-114-89) Avail: NTIS HC/MF A03

Consideration of 1/N-expansion in quantum mechanics, applied to the problem of two Coulomb centers and to the three-body system with pairing interaction is continued. Sequential members of 1/N-expansion for the energy, representing energy of classic motion (E(sub ce)) and quantum corrections for it, have been calculated. Pade approximations and square Pade-Hermite approximations are used for summation of 1/N-expansion. This enables to determine (with high accuracy) term energy even for small quantum members. DOE

N92-14884# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
RELATIVISTIC THEORY OF GRAVITATION BASED ON THE CONSTANT CURVATURE SPACE
A. A. Logunov, M. A. Mestvirishvili, and Yu. V. Chugreev 1990 19 p
(DE91-636027; IHEP-OTF-90-140; IFVE-OTF-90-140) Avail: NTIS HC/MF A03

This paper expounds the basic postulates of the relativistic theory of gravitation on the basis of the constant curvature space, which make it possible to uniquely find the complete system of the equations for gravitational field having a nonzero rest mass. DOE

N92-14885# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
ON THE FUNDAMENTAL PRINCIPLES OF THE RELATIVISTIC THEORY OF GRAVITATION
A. A. Logunov and M. A. Mestvirishvili 1990 16 p
(DE91-636029; IHEP-OTF-90-84; IFVE-OTF-90-84) Avail: NTIS HC/MF A03

This paper expounds consistently, within the frames of the Special Relativity Theory, the fundamental postulates of the Relativistic Theory of Gravitation (RTG) which make it possible to obtain the unique complete system of the equations for gravitational field. Major attention has been paid to the analysis of the gauge group and of the causality principle. Some results related to the evolution of the Friedmann Universe, to gravitational collapse, etc. being the consequences of the RTG equations are also presented. DOE

N92-14886# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
GROSS-NEVEU MODEL AND OPTIMIZED EXPANSION METHOD
K. G. Klimenko 1990 17 p
(DE91-636082; IHEP-OTF-90-95; IFVE-OTF-90-95) Avail: NTIS HC/MF A03

An alternative approach to the study of the D-dimensional (D = 2, 3) Gross-Neveu model using optimized expansion (OE) technique is proposed. A modified optimizing principle for the case of D = 2 and a generalized optimizing principle for D = 3 are proposed which allow to obtain effective potential with an accuracy up to the second OE order. A phase structure, similar to the one in the 1/N expansion method is predicted. DOE

N92-14887# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
SOME PHYSICAL APPLICATIONS OF NONSTANDARD LOGICAL SYSTEMS
N. B. Bogdanova and B. F. Kostenko 1989 9 p In RUSSIAN; ENGLISH summary
(DE91-628004; JINR-R-5-89-402) Avail: NTIS HC/MF A02

A four-valued propositional calculus with two accidental truth values which corresponds to the empirical level of description of physical phenomena with taking into account the Heisenberg uncertainty relation is suggested. Some results of the traditional theory of the quantum measurement are reformulated in a form of simple rules for successive measurements. Arguments are brought showing orthodox or Copenhagen interpretation of quantum mechanics which postulates the coexistence of two different levels of physical phenomena description (quantum and classical) may be determined more accurately on the basis of imaginations of the physical information transmission process. DOE

N92-14888# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE SUMMABILITY OF THE SPECTRAL SHIFT FUNCTION FOR PAIRS OF CONTRACTIONS AND DISSIPATIVE OPERATORS
V. M. Adamyan (Odessa State Univ., USSR) and H. Neidhardt 1989 26 p Submitted for publication
(DE91-628030; JINR-E-5-89-409) Avail: NTIS HC/MF A03

The paper is devoted to the problem of the trace formula for nonunitary and nonself-adjoint operators. It is shown that a summable real spectral shift function can be introduced for a pair of contractions such that the trace formula holds if both contractions differ by an operator which is slightly more compact than a trace class operator. The result is carried over to dissipative operators. An application to the Schroedinger operator is given. DOE

N92-14889# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
FEDOROV UNIVERSAL EQUATIONS IN THE STRING AND MEMBRANE THEORIES
N. S. Shavokhina 1989 20 p In RUSSIAN; ENGLISH summary
(DE91-628073; JINR-R-2-89-566) Avail: NTIS HC/MF A03

It is shown that the equation of minimal hypersurface in the Euclidean (or pseudo-Euclidean) space can be written as the universal Fedorov matrix equation with first-order partial derivatives. Time-like minimal surface in the pseudo-Euclidean Minkowski space describe the free motion of relativistic strings and membranes, whereas space-like surfaces describe the potential in the nonlinear Born electrostatics. All of them are imaginary images of minimal surface of the Euclidean space. Spherically symmetric surfaces are found of all the three types, the hypercatenoid of any dimensionality and its imaginary images - the world surface of a membrane and a potential. The Fedorov equations provides rich information on the minimal surfaces, nonlinear electrostatics and the behavior of strings and membranes. DOE

N92-14890# Joint Inst. for Nuclear Research, Dubna (USSR).
PHASE SPACE STRUCTURE IN GAUGE THEORIES
S. V. Shabanov 1989 88 p In RUSSIAN; ENGLISH summary
(DE91-623483; JINR-R-2-89-533) Avail: NTIS HC/MF A05

The lectures are devoted to the new aspect of dynamical systems with gauge groups, the phase space reduction of physical degrees of freedom. The physical phase space structure in many models with a gauge symmetry and with commuting and anticommuting variables, including Yang-Mills fields and Glashow-Weinberg-Salam model, is studied. Some physical consequences of the phase space reduction are discussed. DOE

N92-14891# Institute of Nuclear Physics, Krakow (Poland).
ANOTHER TREATMENT OF THE RELATION BETWEEN CLASSICAL AND QUANTUM MECHANICS
A. Horzela and E. Kapuscik Apr. 1990 12 p Prepared in cooperation with Joint Inst. for Nuclear Research, Dubna (USSR)
(DE91-641534; INP-1494/PH) Avail: NTIS HC/MF A03

A model of field theory containing as its limits both the Schroedinger wave mechanics and the Newton classical mechanics

is presented. All details are discussed explicitly on the example of the harmonic oscillator. A new fundamental constant connected with the distance of observation of physical phenomena is introduced. Its experimental value may be determined from the spectra of quantum mechanical systems. DOE

N92-14892*# Prairie View Agricultural and Mechanical Coll., TX. Thermal Science Research Center.
FLOW BOILING WITH ENHANCEMENT DEVICES FOR COLD PLATE COOLANT CHANNEL DESIGN Final Report
Ronald D. Boyd 27 Dec. 1991 97 p
(Grant NAG9-310)
(NASA-CR-189518; NAS 1.26:189518) Avail: NTIS HC/MF A05 CSCL 20M

Future space exploration and commercialization will require more efficient heat rejection systems. For the required heat transfer rates, such systems must use advanced heat transfer techniques. Forced two phase flow boiling heat transfer with enhancements falls in this category. However, moderate to high quality two phase systems tend to require higher pressure losses. This report is divided into two major parts: (1) Multidimensional wall temperature measurement and heat transfer enhancement for top heated horizontal channels with flow boiling; and (2) Improved analytical heat transfer data reduction for a single side heated coolant channel. Part 1 summarizes over forty experiments which involve both single phase convection and flow boiling in a horizontal channel heated externally from the top side. Part 2 contains parametric dimensionless curves with parameters such as the coolant channel radius ratio, the Biot number, and the circumferential coordinate. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N92-14893# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
EDUCATION STIMULATION PROJECT COO FOR A30-CT [ONDERWIJSSTIMULERINGSRUIMTEPROJECT C.O.O. VOOR A30-CT]
H. D. Smid and A. Verweij 1990 100 p In DUTCH
(Rept-90-87; ISSN-0920-2358; ETN-92-90375) Copyright Avail: NTIS HC/MF A05

The education stimulation project, Computer Based Instruction (CBI) Linear Algebra, is reported on. A comparison between exercises performed using computers and pen and paper do not show important differences in examination results or student opinion. Hence, the question of whether the same results could be obtained in a much easier and cheaper way without the use of computer based instruction arises. However, this is only possible in theory, since important investments in CBI were realized in the educational sector. It is concluded that the introduction of CBI is not the object in itself, but is a very useful aid within well defined and well organized educational development projects. ESA

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

No abstracts in this category.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-14894*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
EVALUATING THE OPERATIONS CAPABILITY OF FREEDOM'S DATA MANAGEMENT SYSTEM
Henry A. Sowizral Oct. 1990 16 p
(Contract NCC2-387)
(NASA-CR-187315; NAS 1.26:187315; RIACS-TR-90-48) Avail: NTIS HC/MF A03 CSCL 05B

Three areas of Data Management System (DMS) performance are examined: raw processor speed, the subjective speed of the Lynx OS X-Window system, and the operational capacity of the Runtime Object Database (RODB). It is concluded that the proposed processor will operate at its specified rate of speed and that the X-Window system operates within users' subjective needs. It is also concluded that the RODB cannot provide the required level of service, even with a two-order of magnitude (100 fold) improvement in speed. Author

N92-14895# National Inst. of Standards and Technology, Gaithersburg, MD. Information Resources and Services Div.
PUBLICATIONS OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, 1990 CATALOG Report, Jan. - Dec. 1990
Ernestine T. Gladden, ed. Jun. 1991 463 p
(PB91-216531; NIST/SP-305-Suppl-22) Avail: NTIS HC/MF A20; also available SOD HC $23.00 as 003-003-03085-6 CSCL 05B

Full bibliographic citations including keywords and abstracts for National Institute of Standards and Technology (NIST) (formerly National Bureau of Standards (NBS)) papers published and entered into the National Technical Information Service (NTIS) collection are cited in the NIST Publications Announcements section of the catalog. Entries are arranged by NTIS subject classifications which consist of 38 broad subject categories and over 350 subcategories. Within a sub-category, entries are listed alphanumerically by NTIS order number. Four indexes are included to allow the user to identify papers by personal author, keywords, title, and NTIS order/report number. Each entry lists the appropriate title, the NTIS order number, and the abstract number. GRA

N92-14896*# Computer Technology Associates, Inc., Rockville, MD.
STANDARD FORMATTED DATA UNITS-CONTROL AUTHORITY OPERATIONS
Apr. 1991 122 p
(Contract NAS5-30680)
(NASA-CR-188748; NAS 1.26:188748) Avail: NTIS HC/MF A06 CSCL 05B

The purpose of this document is to illustrate a Control Authority's (CA) possible operation. The document is an interpretation and expansion of the concept found in the CA Procedures Recommendation. The CA is described in terms of the functions it performs for the management and control of data descriptions (metadata). Functions pertaining to the organization of Member Agency Control Authority Offices (MACAOs) (e.g., creating and disbanding) are not discussed. The document also provides an illustrative operational view of a CA through scenarios describing interaction between those roles involved in collecting, controlling, and accessing registered metadata. The roles interacting with the CA are identified by their actions in requesting and responding to requests for metadata, and by the type of information exchanged. The scenarios and examples presented in this document are illustrative only. They represent possible interactions supported by either a manual or automated system.

These scenarios identify requirements for an automated system. These requirements are expressed by identifying the information to be exchanged and the services that may be provided by a CA for that exchange. Author

N92-14897*# Computer Technology Associates, Inc., Rockville, MD.
STANDARD FORMATTED DATA UNITS-CONTROL AUTHORITY PROCEDURES Final Report
Apr. 1991 47 p
(Contract NAS5-30680)
(NASA-CR-188127; NAS 1.26:188127) Avail: NTIS HC/MF A03 CSCL 05B

The purpose of this document is to establish a set of minimum and optional requirements for the implementation of Control Authority (CA) organizations within and among the Agencies participating in the Consultative Committee for Space Data Systems (CCSDS). By satisfying these requirements, the resultant cooperating set of CA organizations will produce a global CA service supporting information transfer with digital data under the Standard Formatted Data Unit (SFDU) concept. This service is primarily accomplished through the registration, permanent archiving, and dissemination of metadata in the form of Metadata Objects (MDO) that assist in the interpretation of data objects received in SFDU form. This Recommendation addresses the responsibilities, services, and interface protocols for a hierarchy of CA organizations. The top level, consisting of the CCSDS Secretariat and its operational agent, is unique and primarily provides a global coordination function. The lower levels are Agency CA organizations that have primary responsibility for the registration, archiving, and dissemination of MDOs. As experience is gained and technology evolves, the CA Procedures will be extended to include enhanced services and their supporting protocols. In particular, it is anticipated that eventually CA organizations will be linked via networks on a global basis, and will provide requestors with online automated access to CA services. While this Recommendation does not preclude such operations, it also does not recommend the specific protocols to be used to ensure global compatibility of these services. These recommendations will be generated as experience is gained. Author

N92-14898* National Aeronautics and Space Administration, Washington, DC.
PROGRAM/PROJECT MANAGEMENT INITIATIVE: NASA LIBRARY PROJECT MANAGEMENT COLLECTION
Dec. 1991 49 p
(NASA-TM-105453; NAS 1.15:105453) Avail: Issuing Activity CSCL 05B

This bibliography is the fifth in a series of publications listing 86 reports, articles, and other documents announced in Scientific and Technical Aerospace Reports (STAR) and International Aerospace Abstracts (IAA). In its subject coverage, many issues managers face today are covered. While the emphasis is NASA management, documents from other federal agencies are represented. Each entry consists of a bibliographic citation and an abstract in most cases. The entries are listed by accession number in descending order. Subject, author, corporate source, report number, accession number, and contract number indexes are provided at the end of the bibliography to assist the researcher in identifying pertinent citations. Author

N92-14899# Texas A&M Univ., College Station. Dept. of Industrial Engineering.
THEORETICAL FOUNDATIONS FOR INFORMATION REPRESENTATION AND CONSTRAINT SPECIFICATION Final Report, Jan. 1990 - Mar. 1991
Christopher P. Menzel and Richard J. Mayer Oct. 1991 67 p
(Contract FQ7624-90-00010)
(AD-A241842; KBSL-89-1007; AL-TP-1991-0044) Avail: NTIS HC/MF A04 CSCL 12/5

This paper outlines the theoretical foundations necessary to construct a Neutral Information Representation Scheme (NIRS) which will allow for automated data transfer and translation between model languages, procedural programming languages, database languages, transaction and process languages, as well as knowledge representation and reasoning control languages for information system specification. GRA

N92-14900# Lawrence Livermore National Lab., CA.
REBELS IN SEARCH OF CHAMPIONS: ENVISIONING THE LIBRARY OF THE FUTURE
A. Moulik and D. Lai 21 Jun. 1991 17 p Presented at the 15th International Online Meeting, London, England, 10-12 Dec. 1991
(Contract W-7405-eng-48)
(DE91-016606; UCRL-JC-106995; CONF-911243-1) Avail: NTIS HC/MF A03

The traditional role of librarians to secure and provide access to the archives of recorded knowledge is being rapidly challenged on three fronts: the increasing technical sophistication of library users, the wide availability of information management software, and economic pressures on the growth of library collections. While we may argue endlessly about turf and ownership, the real challenge is to forge a new ethic of librarianship which defies the stereotype of the passive provider of information services, explores new models of partnership with users, and champions an interactive environment in which to create the library of the future. The main library at Lawrence Livermore National Laboratory is actively engaged in testing experimental models of the library of the future, centered on dynamic user-librarian interactions, versatile information technologies, and on forecasting creative partnerships with library users in different environments. These experiments are described, evaluated, and their implications for future development are explored. DOE

N92-14901# Los Alamos National Lab., NM.
OBJECT-ORIENTED DATA HANDLING SYSTEM FOR AN AUTOMATED CHEMISTRY LABORATORY
P. A. Medvick, S. M. Mniszewski, and T. J. Beugelsdijk 1991 13 p Presented at the 1991 International Symposium on Laboratory Automation and Robotics, Boston, MA, 20-23 Oct. 1991
(Contract W-7405-eng-36)
(DE92-000185; LA-UR-91-3075; CONF-9110224-1) Avail: NTIS HC/MF A03

The environmental-remediation efforts at DOE complexes require characterizing problems at each site before cleanup action. Characterization will require the chemical analysis of millions of samples at a significant cost. Automation of the required chemical analyses methods provides a cost-effective solution. An object-oriented approach was deemed necessary to allow for modularization, maintainability, reusability, and flexibility of the software and hardware. Each chemical analysis method is implemented as a Standard Analysis Method or SAM. A SAM is, in essence, a black box into which a sample enters at one end and chemical or physical information exits at the other. DOE

N92-14902*# Arizona Univ., Tucson. Optical Sciences Center.
RESEARCH STUDIES ON ADVANCED OPTICAL MODULE/HEAD DESIGNS FOR OPTICAL DEVICES Quarterly Report
James J. Burke 15 Mar. 1991 262 p
(Grant NAG5-1346)
(NASA-CR-189756; NAS 1.26:189756) Avail: NTIS HC/MF A12 CSCL 05B

A summary is presented of research in optical data storage materials and of research at the center. The first section contains summary reports under the general headings of: (1) Magnetooptic media: modeling, design, fabrication, characterization, and testing; (2) Optical heads: holographic optical elements; and (3) Optical heads: integrated optics. The second section consist of a proposal entitled, Signal Processing Techniques for Optical Data Storage. And section three presents various publications prepared by the center. For individual titles, see N92-14903 through N92-14916.

N92-14903*# Arizona Univ., Tucson. Optical Sciences Center.
CHARACTERIZATION OF MAGNETO-OPTICAL MEDIA **c76**
Roger A. Hajjar, Te-ho Wu, and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 53-69 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

Amorphous rare earth-transition metal (RE-TM) alloys and compositionally modulated TM/TM films were characterized in terms of their magnetic, magneto-optic, and galvanomagnetic properties. The loop tracer, vibrating sample magnetometer (VSM), and Rutherford Backscattering (RBS) facility were used to characterize and analyze the various properties of these magneto-optical storage media. Kerr effect, ellipticity, coercivity, and anisotropy at various temperatures, magnetoresistance, and resistivity are among the properties measured in Co/Pt films, Co/Pd films, and TbFeCo films. Author

N92-14904*# Arizona Univ., Tucson. Optical Sciences Center.
WAVELENGTH DEPENDENCIES OF THE KERR ROTATION AND ELLIPTICITY FOR THE MAGNETO-OPTICAL RECORDING MEDIA
Feng Lei Zhou, J. Kevin Erwin, and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 71-84 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 05B

Here we present wavelength dependence measurements of Co/Pd and Co/Pt superlattice samples with different compositions. We explore the relationship between the composition and the magneto-optical spectra. The induced magnetization in the Pt of Co/Pt or in the Pd of Co/Pd samples plays an important role in the magneto-optical activity, and is discussed for the samples measured. The experimental set-up and the samples used are described. The measurement results of one Co/Pt sample and a series of Co/Pd samples are discussed. Author

N92-14905*# Arizona Univ., Tucson.
COMPARISON OF DIFFERENT FRACTAL DIMENSION MEASURING ALGORITHMS FOR RE-TM M-O FILMS **c61**
Bruce E. Bernacki and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 85-93 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 09B

Noise in magneto-optical recording devices is discussed. In general, it appears that either the divider technique or amplitude spectrum technique may be used interchangeably to measure the fractal dimension (D) in the domain wall structure of ideal images. However, some caveats must be observed for best results. The divider technique is attractive for its simplicity and relatively modest computation requirements. However, it is sensitive to noise, in that noise pixels that touch the domain boundary are interpreted as being part of the boundary, skewing the measurement. Also, it is not useful in measuring nucleation-dominated films or domains that have significant amounts of structure within the interior of the domain wall. The amplitude spectrum method is more complex, and less intuitive than the divider method, and somewhat more expensive to implement computationally. However, since the camera noise tends to be white, the noise can be avoided in the measurement of D by avoiding that portion of the curve that is flat (due to the white noise) when the least squares line is fit to the plot. Also, many image processing software packages include a Fast Fourier Transformation (FFT) facility, while the user will most likely have to write his own edge extraction routine for the divider method. The amplitude spectrum method is a true two dimensional technique that probes the interior of the domain wall, and in fact, can measure arbitrary clusters of domains. It can also be used to measure grey-level images, further reducing processing steps needed to threshold the image. Author

N92-14906*# Arizona Univ., Tucson. Optical Sciences Center.
COERCIVITY OF DOMAIN WALL MOTION IN THIN FILMS OF AMORPHOUS RARE EARTH-TRANSITION METAL ALLOYS **c76**
M. Mansuripur, R. C. Giles, and G. Patterson (Boston Univ., MA.) *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 95-108 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

Computer simulations of a two dimensional lattice of magnetic dipoles are performed on the Connection Machine. The lattice is a discrete model for thin films of amorphous rare-earth transition metal alloys, which have application as the storage media in erasable optical data storage systems. In these simulations, the dipoles follow the dynamic Landau-Lifshitz-Gilbert equation under the influence of an effective field arising from local anisotropy, near-neighbor exchange, classical dipole-dipole interactions, and an externally applied field. Various sources of coercivity, such as defects and/or inhomogeneities in the lattice, are introduced and the subsequent motion of domain walls in response to external fields is investigated. Author

N92-14907*# Arizona Univ., Tucson. Optical Sciences Center.
EFFECT OF PATCH BORDERS ON COERCIVITY IN AMORPHOUS RARE EARTH-TRANSITION METAL THIN FILMS **c76**
G. Patterson (Boston Univ., MA.), H. Fu, R. C. Giles, and M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 109-118 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20L

The coercivity at the micron scale is a very important property of magneto-optical media. It is a key factor that determines the magnetic domain wall movement and domain reversal. How the coercivity is influenced by a special type of patch borders is discussed. Patch formation is a general phenomenon in growth processes of amorphous rare earth transition metal thin films. Different patches may stem from different seeds and the patch borders are formed when they merge. Though little is known about the exact properties of the borders, we may expect that the exchange interaction at the patch border is weaker than that within a patch, since there is usually a spatial gap between two patches. Computer simulations were performed on a 2-D hexagonal lattice consisting of 37 complete patches with random shape and size. From the series of simulations we may conclude that the domain in the patch with borders of 30 percent exchange strength can expand most easily to the whole lattice, because the exchange strength can expand most easily to the whole lattice, because the exchange strength of the border is not too high to prevent the domain from growing within the patch and it is not too low to prevent the domain from expanding beyond the patch. Author

N92-14908*# Arizona Univ., Tucson. Optical Sciences Center.
SOURCES OF NOISE IN MAGNETO-OPTICAL READOUT
M. Mansuripur *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 119-175 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 05B

The various sources of noise which are often encountered in magneto-optical readout systems are analyzed. Although the focus is on magneto-optics, most sources of noise are common among the various optical recording systems and one can easily adapt the results to other media and systems. A description of the magneto-optical readout system under consideration is given, and the standard methods and the relevant terminology of signal and noise measurement are described. The characteristics of thermal noise, which originates in the electronic circuitry of the readout system, are described. The most fundamental of all sources of noise, the shot noise, is considered, and a detailed account of its statistical properties is given. Shot noise, which is due to random fluctuations in photon arrival times, is an ever-present noise in optical detection. Since the performance of magneto-optical recording devices in use today is approaching the limit imposed

by the shot noise, it is important that the reader have a good grasp of this particular source of noise. A model for the laser noise is described, and measurement results which yield numerical values for the strength of the laser power fluctuations are presented. Spatial variations of the disk reflectivity and random depolarization phenomena also contribute to the overall level of noise in readout; these and related issues are treated. Numerical simulation results describing some of the more frequently encountered sources of noise which accompany the recorded waveform itself, namely, jitter noise and signal-amplitude fluctuation noise are presented. Author

N92-14909*# Arizona Univ., Tucson. Optical Sciences Center.
DIFFERENTIAL SPOT-SIZE FOCUS SERVO **c74**
T. D. Milster, M. S. Wang, F. F. Froehlich, J. L. Kann, J. P. Treptau, and K. E. Erwin *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 175-180 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20F

We describe performance of a differential spot-size (wax-wane) focus servo. Crosstalk from the tracks are analyzed in the single detector and differential focus circuits. Magnitude of the crosstalk is reduced by a factor of three in the differential circuit. A false focus-error signal (FES) is present when the spot crosses sector marks at an angle. Author

N92-14910*# Arizona Univ., Tucson. Optical Sciences Center.
MEASUREMENT OF LASER SPOT QUALITY **c36**
T. D. Milster and J. P. Treptau *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 181-186 Submitted for publication (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20E

Several ways of measuring spot quality are compared. We examine in detail various figures of merit such as full width at half maximum (FWHM), full width at 1/(e exp 2) maximum, Strehl ratio, and encircled energy. Our application is optical data storage, but results can be applied to other areas like space communications and high energy lasers. We found that the optimum figure of merit in many cases is Strehl ratio. Author

N92-14911*# Arizona Univ., Tucson. Optical Sciences Center.
LASER BEAM MODELING IN OPTICAL STORAGE SYSTEMS
J. P. Treptau, T. D. Milster, and D. G. Flagello (IBM Watson Research Center, Yorktown Heights, NY.) *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 187-191 (For primary document see N92-14902 05-82)
(Grant NGT-50579)
Avail: NTIS HC/MF A12 CSCL 05B

A computer model has been developed that simulates light propagating through an optical data storage system. A model of a laser beam that originates at a laser diode, propagates through an optical system, interacts with a optical disk, reflects back from the optical disk into the system, and propagates to data and servo detectors is discussed. Author

N92-14912*# Arizona Univ., Tucson. Optical Sciences Center.
MICRO-OPTIC LENS FOR DATA STORAGE
T. D. Milster, R. M. Trusty, M. S. Wang, F. F. Froehlich, and J. Kevin Erwin *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 193-199 Sponsored in part by Arizona Univ., Tucson (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 05B

A new type of microlens for data storage applications that has improved off-axis performance is described. The lens consists of a micro Fresnel pattern on a curved substrate. The radius of the substrate is equal to the focal length of the lens. If the pattern and substrate are thin, the combination satisfies the Abbe sine condition. Therefore, the lens is free of coma. We analyze a 0.5 numerical aperture, 0.50 mm focal length lens in detail. A 0.16 numerical aperture lens was fabricated holographically, and results are presented. Author

N92-14913*# Arizona Univ., Tucson. Optical Sciences Center.
USE OF RIGOROUS VECTOR COUPLED-WAVE THEORY FOR DESIGNING AND TOLERANCING SURFACE-RELIEF DIFFRACTIVE COMPONENTS FOR MAGNETO-OPTICAL HEADS
Charles W. Haggans and Raymond K. Kostuk *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 201-210 Sponsored in part by Arizona Univ., Tucson (For primary document see N92-14902 05-82)
(Grant IBM-SUR-0449)
Avail: NTIS HC/MF A12 CSCL 05B

A rigorous coupled wave model is presented, experimentally validated, and used for tolerancing surface relief diffractive elements. Applications of the model in the design and tolerancing of components for magneto optical (M-O) data storage heads are investigated. Author

N92-14914*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
PRACTICAL DESIGN CONSIDERATIONS AND PERFORMANCE CHARACTERISTICS OF HIGH NUMERICAL APERTURE HOLOGRAPHIC LENSES **c35**
Raymond K. Kostuk *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 211-221 Sponsored in part by IBM, and Arizona Univ., Tucson (For primary document see N92-14902 05-82)
(Grant NSF ECS-89-10067)
Avail: NTIS HC/MF A12 CSCL 14B

The diffraction efficiency of interferometrically formed holographic lenses is influenced by the recording geometry and properties of the recording material. Variations in efficiency increase when attempting to make high numerical aperture elements. The factors which influence the diffraction efficiency of high numerical aperture holographic lenses are examined. Author

N92-14915*# Arizona Univ., Tucson. Optical Sciences Center.
EFFECTS OF BEAM FOCUSING ON THE EFFICIENCY OF PLANAR WAVEGUIDE GRATING COUPLERS **c74**
Lifeng Li and Mool C. Gupta *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 223-228 Repr. from 5320 Applied Optics, v. 29, no. 38, 20 Dec. 1990 Sponsored in part by DTRL/Kodak; and Arizona Univ., Tucson (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 20F

Results of a theoretical and experimental study into the variation of coupling efficiency with a grating angle are presented for various beam focusing conditions for an integrated optical grating coupler. The study shows that the acceptance angle of the grating coupler can be broadened within a relatively large range and with a relatively small loss of coupling efficiency, by focusing the incident laser beam. Author

N92-14916*# Arizona Univ., Tucson. Dept. of Electrical and Computer Engineering.
JITTER MODEL AND SIGNAL PROCESSING TECHNIQUES FOR PULSE WIDTH MODULATION OPTICAL RECORDING
Max M.-K. Liu *In its* Research Studies on Advanced Optical Module/Head Designs for Optical Devices 15 Mar. 1991 p 229-233 (For primary document see N92-14902 05-82)
Avail: NTIS HC/MF A12 CSCL 05B

A jitter model and signal processing techniques are discussed for data recovery in Pulse Width Modulation (PWM) optical recording. In PWM, information is stored through modulating sizes of sequential marks alternating in magnetic polarization or in material structure. Jitter, defined as the deviation from the original mark size in the time domain, will result in error detection if it is excessively large. A new approach is taken in data recovery by first using a high speed counter clock to convert time marks to amplitude marks, and signal processing techniques are used to

minimize jitter according to the jitter model. The signal processing techniques include motor speed and intersymbol interference equalization, differential and additive detection, and differential and additive modulation. Author

N92-14917# Royal Signals and Radar Establishment, Malvern (England).
LIES, DAMNED LIES, AND DATABASES
Simon Wiseman Jul. 1991 23 p
(RSRE-Memo-4503; BR303864; ETN-92-90698) Copyright
Avail: NTIS HC/MF A03

A database is usually expected to give correct and complete answers to queries. However, some applications take confidentiality to an extreme and require the database to receive some users by supplying incorrect answers. In most secure databases classifying sensitive information is enough of a control, since the users will not be surprised to discover that there is information which is too highly classified for them to see. However, there are extreme cases where the existence of such information must be hidden. The database may be required to hide changes made to some information from certain users. Some of the requirements for databases which are intended to deceive some users are examined. The effectiveness of three secure databases implementation techniques in this kind of application are compared. Some example requirements for deceptive databases are given. Security models for three implementation techniques are presented. The suitability of the three techniques is examined with respect to applications which deceive with integrity, and the position is summarized. ESA

N92-14918# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OBJECT-ORIENTED DATA BASE (OODB) CONCEPTS [OODB-BEGRIPPEN]
Henk M. Blanken and Maurice A. W. Houtsma May 1991 17 p In DUTCH
(Memo-INF-91-42; ISSN-0923-1714; ETN-92-90358) Avail: NTIS HC/MF A03

A number of concepts which are important to OODB's are discussed. These are: complex data types, encapsulation, object identity, types and classes, generalization-specialization-categorization, inheritance, overriding and late binding, delegation, scheme evolution and object migration, queries, and impedance mismatch. Some of these objects were also situated in the framework of the ANSI/SPARC three scheme architecture. ESA

N92-14919# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
CAUTIOUS BACKTRACKING AND WELL-FOUNDED SEMANTICS IN TRUTH MAINTENANCE SYSTEMS
C. M. Jonker Jul. 1991 23 p
(RUU-CS-91-26; ISSN-0924-3275; ETN-92-90490) Avail: NTIS HC/MF A03

A Truth Maintenance System (TMS) maintains a consistent state of belief given a set J of justifications, i.e., arguments for belief. To resolve contradictions dependency directed backtracking is performed. Cautious backtracking as a method that can be used to track all dependency directed backtracking methods simultaneously is introduced. This was previously done by adding the contrapositions of justifications to J. Contrapositions are shown not to be mandatory: the same result can be reached by adding one disjunctive justification (the consequent is not one atom, but can be a disjunction of atoms). This cautious backtracking is a minimal backscattering in that the revised beliefs are the beliefs agreed upon by every backtracking method. The well founded model for disjunctive logic programs gives a semantics to cautious backtracking. An alternative proof for the correctness of Witteveen's method for computing the well founded model is given. ESA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N92-14920# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS ACT, 1992
Barbara Mikulski Washington GPO 11 Jun. 1991 107 p H.R. 2519 referred to the Committee on Appropriations, 102d Congress, 1st Session, 11 Jul. 1991
(S-Rept-102-107; HR-2519-RS) Avail: Document Room, Senate, Washington, DC 20510 HC free

An act was passed by the Senate making appropriations for the Departments of Veterans Affairs and Housing and Urban Development, and for sundry independent agencies, commissions, corporations, and offices for the fiscal year ending September 30, 1992, and for other purposes. One of the independent agencies is the National Aeronautics and Space Administration. For individual title, see N92-14921.

N92-14921# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992 11 Jun. 1991 p 80-86 (For primary document see N92-14920 05-84)
Avail: Document Room, Senate, Washington, DC 20510 HC free

Senate committee recommendations for appropriations for the National Aeronautics and Space Administration for the year ending September 30, 1992 are presented. The budget recommendations provide an outline of budgetary information for research and development; space flight, control and data communications; construction of facilities; research and program management; the Office of Inspector General; and administrative provisions. J.P.S.

N92-14922# Congress of the United States, Washington, DC.
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS ACT, 1992
Washington GPO 18 Jul. 1991 114 p H.R. 2519 enacted by the Senate and House of Representatives, 102d Congress, 1st Session, 18 Jul. 1991
(HR-2519-PP) Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

An act was passed by the House of Representatives making appropriations for the Departments of Veterans Affairs and Housing and Urban Development, and for sundry independent agencies, boards, commissions, corporations, and offices for the fiscal year ending September 30, 1992, and for other purposes. One of the independent agencies is the National Aeronautics and Space Administration. For individual title, see N92-14923.

N92-14923# Congress of the United States, Washington, DC.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992 18 Jul. 1991 p 83-90 (For primary document see N92-14922 05-84)

Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

House committee recommendations for appropriations for the National Aeronautics and Space Administration for the fiscal year ending September 30, 1992 are presented. The budget recommendations provide an outline of budgetary information for research and development; construction of facilities; space flight, control and data communication; research and program management; the Office of Inspector General; and administrative provisions. J.P.S.

N92-14924# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS BILL, 1992
Barbara Mikulski Washington GPO 1991 181 p Report to accompany H.R. 2519 presented by the Committee on Appropriations, 102d Congress, 1st Session, 11 Jul. 1991
(S-Rept-102-107; GPO-44-871) Avail: Document Room, Senate, Washington, DC, 20510 HC free

A bill was submitted to the Senate for appropriations for the Departments of Veterans Affairs and Housing and Urban Development, and for sundry independent agencies, boards, commissions, corporations, and offices for the fiscal year ending September 30, 1992, and for other purposes. One of the independent agencies is the National Aeronautics and Space Administration. For individual title, see N92-14925.

N92-14925# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992 1991 p 130-148 (For primary document see N92-14924 05-84)
Avail: Document Room, Senate, Washington, DC, 20510 HC free

Senate committee recommendations for appropriations for the National Aeronautics and Space Administration for the fiscal year ending September 30, 1992 are presented. The budget recommendations provide an outline of budgetary information for space transportation; space sciences; commercial, technology, and educational programs; air and space flight; communications; propulsion; international radio astronomy programs; construction of facilities; and research and program management. J.P.S.

N92-14926# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT AND INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1992, PART 2
Washington GPO 1991 593 p Hearings on H.R. 2519 before the Committee on Appropriations, 102d Congress, 1st Session, 30 Sep. 1992
(S-Hrg-102-113-Pt-2; GPO-38-725; ISBN-0-16-035789-6) Avail: Committee on Appropriations, Senate, Washington, DC, 20510 HC free

Hearings before a subcommittee of the Senate Committee on Appropriations are presented along with budget estimates for the Departments of Veterans Affairs and Housing and Urban Development, and independent agencies, one of which is the National Aeronautics and Space Administration, for the fiscal year ending September 30, 1992. All written testimony and submittals for the record are included. For individual title, see N92-14927.

N92-14927# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development and Independent Agencies Appropriations for Fiscal Year 1992, Part 2 1991 p 297-395 (For primary document see N92-14926 05-84)
Avail: Committee on Appropriations, Senate, Washington, DC, 20510 HC free

Following opening statements of members of the subcommittee of the Senate Committee on Appropriations, the National Aeronautics and Space Administration presents its fiscal year 1992 budget. Previous and planned programs are discussed. It is noted that the entire NASA budget equals only a little over 1 percent of the total Federal budget, and that 99 percent of NASA's $15.8 billion is needed for ongoing programs. The subcommittee noted that Congress and the General Accounting Office use different standards in measuring science and space programs. Concern was expressed for the future impact of current science and space program underfunding. Questions submitted to NASA after the hearing, and their answers, are included in the record. Topics discussed include NASA's priorities, a strategic plan, budget reserves, the space station, shuttles, the advanced solid rocket motor, Mission to Planet Earth, a new launch vehicle, the Mars Observer, Landsat, education, communications, management, commerce, NASA field Center maintenance, and technology and information transfer. J.P.S.

N92-14928# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA'S FISCAL YEAR 1992 BUDGET OVERVIEW
Washington GPO 1991 80 p Hearing before the Committee on Commerce, Science, and Transportation, 102d Congress, 1st Session, 19 Apr. 1991
(S-Hrg-102-269; GPO-48-180; ISBN-0-16-036851-0) Avail: Subcommittee on Science, Technology, and Space, Senate, Washington, DC 20510 HC free; also available SOD HC $2.50 as 552-070-11469-6

Hearings before the Subcommittee on Science, Technology, and Space of the Senate Committee on Commerce, Science, and Transportation are presented. The subject was an overview of the National Aeronautics and Space Administration's budget estimates for the fiscal year 1992. An effort is made to resolve differences among recommendations and priorities set by the Augustine Commission, NASA, international commitments, Congress, AIAA, the Advisory Committee on the Future of the U.S. Space Program, environmental needs, laws setting appropriation limitations, and the Office of Management and Budget. J.P.S.

N92-14929# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA'S PLAN TO RESTRUCTURE THE SPACE STATION FREEDOM
Washington GPO 1991 126 p Hearing before the Committee on Commerce, Science, and Transportation, 102d Congress, 1st Session, 16 Apr. 1991
(S-Hrg-102-268; GPO-46-368; ISBN-0-16-036846-4) Avail: Subcommittee on Science, Technology, and Space, Senate, Washington, DC 20510 HC free; also available SOD HC $3.75 as 552-070-11444-1

Hearings before the Subcommittee on Science, Technology, and Space of the Senate Committee on Commerce, Science, and Transportation on NASA's plans to restructure Space Station Freedom are presented. This was a preliminary to the hearings on the overall NASA budget request for fiscal year 1992. All written testimony and submittals for the record are included. The hearings address the importance of good communication between: (1) NASA and the Congress on the costs of the Space Station; and (2) the U.S. and its international partners on any changes to the Space Station project. Statements on the new space station design were made by the Space Studies Board, National Academy of Sciences; the Space Station Science and Applications Advisory Subcommittee, Vanderbilt University; the Aerospace Medical Advisory Committee, Bethesda; the Planetary Society, Pasadena, CA; and the Space Policy Project Director, Federation of American Scientists, Washington, DC. J.P.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-14930* National Aeronautics and Space Administration, Washington, DC.
NASA SPINOFF, 1990
1990 158 p Original contains color illustrations
(NASA-NP-138; NAS 1.83:138) Avail: Issuing Activity; also available SOD HC $11.00 as 033-000-01087-7; 139 functional color pages CSCL 05A

This publication is intended to foster the aim of the NASA Technology Utilization Program by heightening awareness of the NASA technology available for transfer and its potential for benefits realized by secondary applications. Spinoff 1990 is organized in three main sections. Section 1 outlines NASA's mainline effort, the major programs that generate new technology and therefore replenish and expand the bank of knowledge available for transfer. Section 2 contains a representative sampling of spinoff products that resulted from secondary application of technology originally developed to meet mainline goals. Section 3 describes the various mechanisms NASA employs to stimulate technology transfer and lists, in an appendix, contact sources for further information about the Technology Utilization Program. M.G.

N92-14931* National Aeronautics and Space Administration, Washington, DC.
SPINOFF, 1989
James J. Haggerty Aug. 1989 138 p Original contains color illustrations
(NASA-TM-105112; NAS 1.15:105112) Avail: Issuing Activity; 128 functional color pages CSCL 05A

This publication is intended to foster the aim of the NASA Technology Utilization Program by heightening awareness of the NASA technology available for transfer and its potential for benefits realized by secondary applications. Spinoff 1989 is organized in three main sections. Section 1 outlines NASA's mainline effort, the major programs that generate new technology and therefore replenish and expand the bank of knowledge available for transfer. Section 2 contains a representative sampling of spinoff products that resulted from secondary application of technology originally developed to meet mainline goals. Section 3 describes the various mechanisms NASA employs to stimulate technology transfer and lists, in an appendix, contact sources for further information about the Technology Utilization Program. M.G.

N92-14932* National Aeronautics and Space Administration, Washington, DC.
SPINOFF, 1988
James J. Haggerty Aug. 1988 150 p Original contains color illustrations
(NASA-TM-105111; NAS 1.15:105111) Avail: Issuing Activity; 136 functional color pages CSCL 05A

This publication is intended to foster the aim of the NASA Technology Utilization Program by heightening awareness of the NASA technology available for transfer and its potential for benefits realized by secondary applications. Spinoff 1988 is organized in three main sections. Section 1 outlines NASA's mainline effort, the major programs that generate new technology and therefore replenish and expand the bank of knowledge available for transfer. Section 2 contains a representative sampling of spinoff products that resulted from secondary application of technology originally developed to meet mainline goals. Section 3 describes the various mechanisms NASA employs to stimulate technology transfer and lists, in an appendix, contact sources for further information about the Technology Utilization Program. M.G.

N92-14933# Office of Technology Assessment, Washington, DC.
NEW WAYS: TILTROTOR AIRCRAFT AND MAGNETICALLY LEVITATED VEHICLES
1992 118 p
(OTA-SET-507; ISBN-0-16-035630-X) Avail: NTIS HC/MF A06

The Office of Technology Assessment presents a study on tiltrotor aircraft and magnetically levitated (maglev) vehicular technology. The purpose of the study was to provide the House Committee on Appropriations with information that would aid their decisionmaking on how much and what kind of additional investment they should make in these new technologies to help resolve transportation congestion. Federal policy issues are presented, as well as various options for operational implementation. J.P.S.

N92-14934# National Science Foundation, Washington, DC. Div. of International Programs.
INTERNATIONAL SCIENCE AND TECHNOLOGY INSIGHT, VOLUME 3, NUMBER 1
Emily B. Rudin, ed. 1991 53 p
(NSF-91-14) Avail: NTIS HC/MF A04

A compilation is presented of articles devoted to information and analysis on foreign science and technology policy, research developments and program, and international cooperation in science and engineering research and education. Some representative titles include the following: Science in Bulgaria; Electronic Communications in the Soviet Union; Science Policy in India - What Directions in a Multipolar World; U.S. Cooperation with the Soviet Union in Nuclear Energy. E.R.

N92-14010# Transportation Development Centre, Montreal (Quebec).
TDC: INNOVATION IN TRANSPORT
N. E. Rudback *In* Communications Gillies, Inc., Electronic Systems in Transportation Sep. 1989 p 2-4 (For primary document see N92-14009 05-04)
Avail: Transportation Development Centre, 200 Rene Levesque Blvd. West, West Tower, Ste 601, Montreal, PQ H2Z 1X4 Canada

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-14935*# American Science and Engineering, Inc., Cambridge, MA.
SOLAR X RAY ASTRONOMY ROCKET PROGRAM Final Report
29 Nov. 1990 140 p
(Contract NAS5-31619)
(NASA-CR-183494; NAS 1.26:183494; ASE-5752) Avail: NTIS HC/MF A07 CSCL 03A

The dynamics were studied of the solar corona through the imaging of large scale coronal structures with AS&E High Resolution Soft X ray Imaging Solar Sounding Rocket Payload. The proposal for this program outlined a plan of research based on the construction of a high sensitivity X ray telescope from the optical and electronic components of the previous flight of this payload (36.038CS). Specifically, the X ray sensitive CCD camera was to be placed in the prime focus of the grazing incidence X ray mirror. The improved quantum efficiency of the CCD detector (over the film which had previously been used) allows quantitative

measurements of temperature and emission measure in regions of low x ray emission such as helmet streamers beyond 1.2 solar radii or coronal holes. Furthermore, the improved sensitivity of the CCD allows short exposures of bright objects to study unexplored temporal regimes of active region loop evolution. Author

N92-14936 Cornell Univ., Ithaca, NY.
RADIO FREQUENCY INVESTIGATIONS OF THE INTERSTELLAR MEDIUM Ph.D. Thesis
Andrew Wallace Clegg 1991 264 p
Avail: Univ. Microfilms Order No. DA9113393

The results of four projects are presented. (1) Ten interstellar OH (HII/OH) masers were monitored over 2 yrs using high spectral and temporal resolution. Eight of the objects exhibited spectral fluctuations on time scales as short as minutes. (2) Recombination line emission towards six pulsars was searched for and not found. Combined with limits on the intensity of continuum emission, the electron temperature of the emitting material is constrained as a function of the filling factor along the line of sight. (3) Interstellar shocks of certain thickness and column density are capable of producing observable flux modulations and multiple images of background point radio sources. Refraction events are frequent if the effective cross section of the front is enhanced by turbulence and nonuniformities that distort the shock interface on scales of approx. 1 au. (4) The magnetoionic component of the interstellar medium was probed by Faraday rotation measurements of background extragalactic radio sources. Salient results include an estimate of the random component of interstellar Faraday rotation, and its origin derived solely from known interstellar electron density turbulence. Author

N92-14937*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
A SEARCH FOR PERIODICITY IN THE X RAY SPECTRUM OF BLACK HOLE CANDIDATE A0620-00 Final Technical Report
George W. Clark and Kenneth Plaks 1991 10 p
(Grant NAGw-1694)
(NASA-CR-186715; NAS 1.26:186715) Avail: NTIS HC/MF A02 CSCL 03A

The archived data from the SAS-3 observations of the X-ray nova A0620-00, the best of the stellar blackhole candidates, were exhaustively examined for evidence of variable phenomena correlated with the orbital motion of the binary system of which it is a member. The original analysis of these data was completed before discovery of the binary companion and determination of the orbital period of the system. New interest was drawn to the task of a reexamination of the archive data by the recent discovery of the massive nature of the X-ray source through analysis of the Doppler variations and ellipsoidal light variations of the faint K-star companion by McClintock and Remillard. The archive research, carried out under the supervision of the principal investigator, was the topic of the thesis submitted to the MIT Department of Physics by Kenneth Plaks in partial fulfillment of the requirements for the degree of Master of Science. Plaks' effort was focused on the elimination of fluctuations in the data due to errors in attitude solutions and other extraneous causes. The first products of his work were long-term light curves of the X-ray intensities in the various energy channels as functions of time during the time from outbursts in August 1975 to quiescence approximately 6 months later. These curves, are refined versions of the preliminary results published in 1976 (Matilsky et al. 1976). Smooth exponentials were fitted to these long term light curves to provide the basis for detrending the data, thereby permitting a calculation of residuals derived by subtracting the fitted curve from the data. The residuals were then analyzed by Fourier analysis to search for variations with the period of the binary orbit, namely 7.75 hours. No evidence of an orbital periodicity was found. However, the refined light curve provides a much clearer picture of the outburst and subsequent decay of the X-ray luminosity. In fact, there were two outbursts, each followed by an exponential decay with similar time constants of about 25 days. Previous evidence of a three-oscillation variation with a 7.8 day period were confirmed. Substantial theoretical effort has been devoted to attempts to account for the decay characteristics as the result of the gradual eating up of an accretion disk by a stellar-mass blackhole (e.g., Huang and Wheeler 1989). The improved decay curves will provide significant new constraints on the theoretical analyses. Author

N92-14089*# Space Telescope Science Inst., Baltimore, MD.
AN ANALYSIS OF THE HUBBLE SPACE TELESCOPE FINE GUIDANCE SENSOR FINE LOCK MODE
L. G. Taff *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 333-352 (For primary document see N92-14070 05-13)
(Contract NAS5-26555)
Avail: NTIS HC/MF A21 CSCL 03A

N92-14090*# Computer Sciences Corp., Laurel, MD.
THE IN-FLIGHT CALIBRATION OF THE HUBBLE SPACE TELESCOPE ATTITUDE SENSORS
Gary L. Welter *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991 Oct. 1991 p 353-381 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N92-14938 Michigan Univ., Ann Arbor.
EMPIRICAL POPULATION SYNTHESIS: NEW DIRECTIONS Ph.D. Thesis
David Richard Silva 1991 176 p
Avail: Univ. Microfilms Order No. DA9124105

Empirical population synthesis (EPS) is a technique to decompose composite galaxy stellar populations into their component populations. From this decomposition, a stellar luminosity function is derived and used to analyze the star formation history of the observed galaxy population. EPS is used to investigate the nuclear stellar populations of the spiral galaxies NGC 1219, NGC 3177, NGC 3512, and NGC 4032. An EPS algorithm based on linear combinations of stellar spectra is implemented and tested. A maximum entropy variant is also tested. The effects of stellar spectra degeneracy on EPS solutions are investigated. Stellar degeneracy is quantified using linear correlation analysis. A Monte Carlo technique is implemented to estimate the uncertainties of the derived individual stellar components. Medium resolution (12 A) data spanning 3500-9000A were acquired for the four galaxies above. A stellar spectral library with good luminosity and temperature discrimination was also constructed. Using these data and EPS, luminosity functions are derived for the observed spiral nuclei. Component uncertainties are calculated and the effects of uncertain continuum determination on these uncertainties is discussed. Data for the irregular galaxies NGC 1569 and NGC 4449 were also acquired but detailed luminosity functions are not derived. It is concluded that NGC 4032 has undergone constant, continual star formation over the last 10 Gyr. NGC 3512 luminosity function analysis indicates a declining mean star formation rate (SFR) with a burst of star formation 1-2 Gyr ago. While NGC 3177 and NGC 3512 appear spectroscopically similar; NGC 3177 is found to have a much higher current SFR than NGC 3512. The NGC 3177 result is shown to be less certain. No conclusive star formation history can be derived for NGC 1219 using the current data. The nature of the observed stellar populations in NGC 1569 and NGC 4449 are discussed. Evidence of young, red supergiants in the brightest star forming region of NGC 1569 suggests that the dominant population in this region must be very young (less than or = 10 Myr). Dissert. Abstr.

N92-14939*# Smithsonian Astrophysical Observatory, Cambridge, MA.
AN ASTROPHYSICS DATA PROGRAM INVESTIGATION OF A SYNOPTIC STUDY OF QUASAR CONTINUA Final Report, 1 Oct. 1987 - 30 Sep. 1990
Martin Elvis Sep. 1991 254 p
(Contract NAS8-30751; NAG8-689; NAG5-1201)
(NASA-CR-189003; NAS 1.26:189003) Avail: NTIS HC/MF A12 CSCL 03B

A summary of the program is presented. The major product of the program, an atlas of quasar energy distributions, is presented in the appendices along with papers written as a result of this research. The topics covered in the papers include: (1) accurate galactic N(sub h) values toward quasars and active galactic nuclei (AGN); (2) weak bump quasars; (3) millimeter measurements of hard x ray selected active galaxies- implications for the nature of the continuous spectrum; (3) persistence and change in the soft x ray spectrum of the quasar PG1211+143; (4) the soft x ray excess in einstein quasar spectra; and (5) EXOSAT x ray spectra of quasars. Author

N92-14940# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
QUALITATIVE ANALYSIS OF COSMOLOGICAL MODELS IN BRANS-DICKE THEORY, SOLUTIONS FROM NON-MINIMAL COUPLING AND VISCOUS UNIVERSE Ph.D. Thesis
C. A. RomeroFilho 1988 182 p In PORTUGUESE; ENGLISH summary
(DE91-634422; INIS-BR-2431) Avail: NTIS HC/MF A09

Using dynamical system theory we investigate homogeneous and isotropic models in Brans-Dicke theory for perfect fluids with general equation of state and arbitrary (omega). Phase diagrams are drawn on the Poincare sphere which permits a qualitative analysis of the models. Based on this analysis, we construct a method for generating classes of solutions in Brans-Dicke theory. The same technique is used for studying models arising from nonminimal coupling of electromagnetism with gravity. In addition, viscous fluids are considered and nonsingular solutions with bulk viscosity are found. DOE

N92-14941# California Univ., Berkeley. Lawrence Berkeley Lab.
ROTATING RELATIVISTIC NEUTRON STARS
F. Weber and N. K. Glendenning 21 Jul. 1991 100 p Presented at the International Summer School on Nuclear Astrophysics, Tianjin (China), 17-27 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-000806; LBL-29106; CONF-9106283-1) Avail: NTIS HC/MF A05

Models of rotating neutron stars are constructed in the framework of Einstein's theory of general relativity. For this purpose a refined version of Hartle's method is applied. The properties of these objects, e.g., gravitational mass, equatorial and polar radius, eccentricity, red- and blueshift, quadrupole moment, are investigated for Kepler frequencies of 4000/s less than Omega sub K less than 9000/s. Therefore a self-consistency problem inherent in the determination of Omega sub K must be solved. The investigation is based on neutron star matter equations of state derived from the relativistic Martin-Schwinger hierarch of coupled Green's functions. By means of introducing the Hartree, Hartree-Fock, and ladder (Lambda) approximations, models of the equation of statem are derived. A special feature of the latter approximation scheme is the inclusion of dynamical two-particle correlations. These have been calculated from the relativistic T-matrix applying both the HEA and Bonn meson-exchange potentials of the nucleon-nucleon force. The nuclear forces of the former two treatments are those of the standard scalar-vector-isovector model of quantum hadron dynamics, with parameters adjusted to the nuclear matter data. An important aspect of this work consists in testing the compatibility of different competing models of the nuclear equation of state with data on pulsar periods. By this the fundamental problem of nuclear physics concerning the behavior of the equation of state at supernuclear densities can be treated. DOE

N92-14942# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
ANALYSIS OF THE RESULTS OF CALIBRATING METEORITIC OLIVINE CRYSTALS WITH U-238 NUCLEI AT THE BEVALAC ACCELERATOR
V. P. Perelygin, S. G. Stetsenko (Joint Inst. for Nuclear Research, Dubna, USSR), H. J. Crafword, and T. M. Symons 1989 19 p
(DE91-628619; JINR-E-7-89-88) Avail: NTIS HC/MF A03

The results are presented of calibrating the sensitivity of olivine crystals from meteorites by the U-238 nuclei produced at the Bevalac accelerator. The comparative studies of the spectra of the etchable track lengths due to the U-235 nuclei and to fossil tracks in these olivines have shown that the group of the (similar to) 210 micron fossil tracks observed in 1980 at the LNR, Laboratory of Neutron Physics (JINR) is due to the galactic cosmic-ray nuclei of the Th-U group. The possible ways of the unambiguous identification of the group of the abnormally long tracks, 340-360 microns in length, from the cosmic-ray nuclei are discussed. DOE

N92-14943*# Northwest Research Associates, Inc., Bellevue, WA.
REPORT ON THE SEARCH FOR ATMOSPHERIC HOLES USING AIRS IMAGE DATA Final Report, 27 Sep. 1990 - 26 Sep. 1991
Lee A. Reinleitner 13 Dec. 1991 33 p
(Contract NASw-4535)
(NASA-CR-187902; NAS 1.26:187902; NWRA-CR-91-R074)
Avail: NTIS HC/MF A03; 3 functional color pages CSCL 03B

Frank et al (1986) presented a very controversial hypothesis which states that the Earth is being bombarded by water-vapor clouds resulting from the disruption and vaporization of small comets. This hypothesis was based on single-pixel intensity decreases in the images of the earth's dayglow emissions at vacuum-ultraviolet (VUV) wavelengths using the DE-1 imager. These dark spots, or atmospheric holes, are hypothesized to be the result of VUV absorption by a water-vapor cloud between the imager and the dayglow-emitting region. Examined here is the VUV data set from the Auroral Ionospheric Remote Sensor (AIRS) instrument that was flown on the Polar BEAR satellite. AIRS was uniquely situated to test this hypothesis. Due to the altitude of the sensor, the holes should show multi-pixel intensity decreases in a scan line. A statistical estimate indicated that sufficient 130.4-nm data from AIRS existed to detect eight to nine such holes, but none was detected. The probability of this occurring is less than 1.0 x 10(exp -4). A statistical estimate indicated that sufficient 135.6-nm data from AIRS existed to detect approx. 2 holes, and two ambiguous cases are shown. In spite of the two ambiguous cases, the 135.6-nm data did not show clear support for the small-comet hypothesis. The 130.4-nm data clearly do not support the small-comet hypothesis. Author

N92-14944*# Virginia Univ., Charlottesville.
EMISSION PROCESSES AND DYNAMICS OF HOT GASES IN ASTROPHYSICS Final Report, 1 Mar. 1988 - 30 May 1991
Roger A. Chevalier and Craig L. Sarazin 1991 20 p
(Grant NAGw-764)
(NASA-CR-189465; NAS 1.26:189465) Avail: NTIS HC/MF A03 CSCL 03B

A detailed model was developed for Kepler's supernova remnant (SNR). Observations of the SNR revealed a strong interaction with the surrounding circumstellar medium, which was studied through both analytical and numerical calculations. Effects were studied of electron thermal conduction on the structure of radiative interstellar shock waves. An explanation is sought for the observed line emission from metal rich ejecta in SNR, incorporating atomic data. Light echoes around SN 1987A was also studied. Analysis of infrared and scattered circumstellar light echoes was accomplished with early observations to set limits on the mass of circumstellar dust. Work was completed on the emission from

heavy element gas ejected in the supernova explosion of massive stars. It was assumed that a radioactive energy source was present and calculated the detailed heating and ionization of the gas. The evolution was studied of SNR in the very high pressure environment of a starburst galaxy. Author

N92-14945*# Columbia Univ., New York, NY. Dept. of Astronomy.
ABSORPTION OF THE X RAY BACKGROUND BY THE LARGE MAGELLANIC CLOUD Final Report, 1 Jun. 1990 - 30 Apr. 1992
Thomas T. Hamilton Dec. 1991 9 p
(Grant NAG5-1362)
(NASA-CR-189462; NAS 1.26:189462; CAL-1946) Avail: NTIS HC/MF A02 CSCL 03B

Soft x ray flux of extragalactic origin should be partially absorbed during passage through the Large Magellanic Cloud. Past attempts to measure this absorption have been frustrated by the LMC's intrinsic x ray emission. New calibration techniques were developed to enable precise (within 5 pct.) measurement of the flux and spectrum of diffuse x rays detected by the Einstein Observatory IPC. These techniques were used to measure the absorption of extragalactic flux by neutral gas in the LMC, and to determine that at least 50 pct. of the observed flux in the 0.16 to 2 keV band is of extragalactic origin. Author

N92-14946# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
GRAVITATIONAL WAVES ON THE COSMOLOGICAL BACKGROUND IN RELATIVISTIC THEORY OF GRAVITATION WITH NONZERO REST MASS OF GRAVITON
Yu. V. Chugreev 1989 22 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE91-623494; IFVE-OTF-89-143) Avail: NTIS HC/MF A03

In the frameworks of relativistic theory of gravitation with nonzero graviton rest mass theory of gravitational wave radiation is built with the source being embeded in infinite and oscillating Friedmann Universe. If the source has a nonzero quadrupole moment intensity of radiation is described by usual quadrupole formula, otherwise (spherically symmetric case) the intensity is strongly suppressed but positive. DOE

N92-14947# Institute of Nuclear Physics, Krakow (Poland).
SPIN ORDERING IN DENSE MATTER AND MAGNETIC FIELDS OF NEUTRON STARS
M. Kutschera and W. Wojcik Aug. 1990 39 p
(DE91-641846; INP-1501/PH) Avail: NTIS HC/MF A03

The spin properties of the ground-state dense baryon matter are discussed in the nucleon as well as in the quark phase. Predictions for magnetic properties of neutron stars possessing a ferromagnetic core are given. Astrophysical measurements of the magnetic fields of neutron stars are reviewed. An attempt is made to reproduce the data with the ferromagnetic core model. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-14948 Southern Methodist Univ., Dallas, TX.
GRAVITY AND TOPOGRAPHY OF VENUSIAN HIGHLANDS: IMPLICATIONS FOR FORMATION MECHANISMS Ph.D. Thesis
Suzanne Elizabeth Smrekar 1990 99 p
Avail: Univ. Microfilms Order No. DA9119920

Gravity and topography data are used to determine the apparent compensation depths (ADC's) of thirteen venusian regions. The depths are interpreted in terms of the likely tectonic origins of each area. First, three geologically distinct regions are studied in detail by inverting Pioneer Venus line of sight gravity data to obtain a model of vertical gravity over Bell Regio (possible hot spot), Tellus Regio (tessera terrain), and Leda Planitia (plains). The admittance spectra, the geoid to topography ratio (GTR), and the ADC for each region are found. Each area has a distinct gravity signature. The shallow ADC at Tellus Regio (approximately 25 km) indicates that crustal compensation, possibly with some thermal compensation, is most likely. The large ADC (approximately 175 km) and GTR (20 m/km) along with an unusual admittance spectra at Bell Regio indicate that some dynamic compensation is necessary; crustal or thermal compensation may also be present. Leda Planitia has an intermediate ADC (approximately 65 km), which indicates either thermal or crustal compensation. Second, ADC's and GTR's for 12 venusian highland regions are estimated directly from the topography and line of sight gravity data. These features are: Asteria, Atla, Bell, Beta, Ovda, Phoebe, Tellus, Thetis, and Ulfrun Regiones; Nokomis, Gula, and Sappho Montes. The ADC's range is 50-270 km; the GTR's range is 7-31 m/km. Two distinct GTR groups are apparent. The lower GTR group is best modeled by compensation due to thermal thinning of the lithosphere; some minor component of dynamic or crustal compensation may also be present. A fit to the upper GTR group requires dynamic compensation; a lesser contribution from thermal or crustal compensation may also be present. Upper mantle convection without a low viscosity zone can fit the data. Although the convection parameters are not well constrained, the best fit occurs for a conductive lid thickness of 105 km and a Rayleigh number of 10(exp 5). These results indicate that hot spots are likely to make a significant contribution to heat loss on Venus. Dissert. Abstr.

N92-14949*# Lunar and Planetary Inst., Houston, TX.
SCIENTIFIC RATIONALE AND REQUIREMENTS FOR A GLOBAL SEISMIC NETWORK ON MARS
Sean C. Solomon, Don L. Anderson, W. Bruce Banerdt, Rhett G. Butler, Paul M. Davis, Frederick K. Duennebier, Yosio Nakamura, Emile A. Okal, and Roger J. Phillips (Southern Methodist Univ., Dallas, TX.) 1991 48 p Workshop held at Morro Bay, CA, 7-9 May 1990
(Contract NASw-4574)
(NASA-CR-188806; NAS 1.26:188806; LPI-TR-91-02) Avail: NTIS HC/MF A03 CSCL 03B

Following a brief overview of the mission concepts for a Mars Global Network Mission as of the time of the workshop, we present the principal scientific objectives to be achieved by a Mars seismic network. We review the lessons for extraterrestrial seismology gained from experience to date on the Moon and on Mars. An important unknown on Mars is the expected rate of seismicity, but theoretical expectations and extrapolation from lunar experience both support the view that seismicity rates, wave propagation characteristics, and signal-to-noise ratios are favorable to the collection of a scientifically rich dataset during the multiyear operation of a global seismic experiment. We discuss how particular types of seismic waves will provide the most useful information to address each of the scientific objectives, and this discussion provides the basis for a strategy for station siting. Finally, we define the necessary technical requirements for the seismic stations. Author

N92-14950 Michigan Univ., Ann Arbor.
MODEL STUDIES OF THE IONOSPHERE OF VENUS: ION COMPOSITION, ENERGETICS AND DYNAMICS Ph.D. Thesis
Jhoon Kim 1991 202 p
Avail: Univ. Microfilms Order No. DA9124034

A number of existing models are expanded and new ones developed in order to improve our understanding of the ionosphere of Venus. The hot oxygen and hydrogen models of Nagy et al. (1981), and Cravens et al. (1980) are used to study the hot atom corona around Venus and Mars, and to investigate the O(+) ion heating by hot oxygen, in conjunction with a multispecies energy model. A photochemical model is used to calculate the electron densities for both solar cycle maximum and minimum daytime conditions; the results of this model are compared with the radio occultation measurements. A multispecies temperature model is developed and used to study the energetics of different ion species.

The temperature differences between the ions is found to be small. The O(+) ion heating mechanism from charge exchange between the O(+) ions and hot oxygens is also studied with the multi-temperture model. A comprehensive magnetohydrodynamic (MHD) model, which solves the coupled continuity, momentum, energy, and Maxwell's equations, is presented and used to study the interaction between the MHD and energetics components of the model. The typical high altitude ion velocities, directed toward the nightside, are supersonic, according to the PV measurements. The results from a two-dimensional ionospheric model are presented which solve the coupled continuity, momentum, and energy equations, using a second-order form of the shock-capturing Godunov scheme, with heat conduction. These results elucidate the importance of these high speed flows and address in a quantitative way, the issue of shock formation in the nightside ionosphere of Venus. Dissert. Abstr.

N92-14951# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
NUCLEAR TECHNOLOGIES FOR MOON AND MARS EXPLORATION
D. Buden 1991 7 p Presented at the 42nd International Aeronautical Federation Congress (IAEFC), Montreal, Quebec, 7-11 Oct. 1991 Previously announced in IAA as A92-12459
(Contract DE-AC07-76ID-01570)
(DE91-018832; EGG-M-91352; CONF-9110217-1) Avail: NTIS HC/MF A02

Nuclear technologies are essential to successful Moon and Mars exploration and settlements. The advantages gained by using nuclear technologies for long-term space missions are discussed. Applications can take the form of nuclear propulsion for transport of crews and cargo to Mars and the Moon; surface power for habitats and base power; power for human spacecraft to Mars; shielding and life science understanding for protection against natural solar and cosmic radiations; radioisotopes for sterilization, medicine, testing, and power; and resources for the benefits of Earth. DOE

N92-14952# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
NONLINEAR PLASMA VORTICES IN THE JUPITER MAGNETOSPHERE AND RADIAL DIFFUSION IN THE RADIATION BELT
A. P. Kropotkin and A. R. Mozzhukhina 1989 16 p In RUSSIAN
(DE91-623793; NIIYaF-MGU-89-35-112) Avail: NTIS HC/MF A03

Within the framework of representations about two-dimensional vortex character of hydrodynamic turbulence in Jo torus linked with the development of rearrangement (flute) instability of torus plasma, nonlinear equations describing such disturbances with regard to ionospheric conductivity effect are derived. Evaluations of chacteristic size of a vortex and value of electric field disturbances are found. Energetic particle radial diffusion coefficient in the Jo torus region is calculated, radial diffusion equation with model losses is solved. DOE

N92-14953*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OVERVIEW OF Ka-BAND COMMUNICATIONS TECHNOLOGY REQUIREMENTS FOR THE SPACE EXPLORATION INITIATIVE
Edward F. Miller 1991 11 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; cosponsored by AIAA, NASA, and OAI Previously announced in IAA as A91-52344
(NASA-TM-105308; E-6661; NAS 1.15:105308; AIAA-91-3424)
Avail: NTIS HC/MF A03 CSCL 03B

In the Space Exploration Initiative, Ka-band frequencies are likely to carry the bulk of the communications traffic both in the vicinity of and on the return links from the moon and Mars. The four exploration architectures identified by the Synthesis Group are examined and Ka-band technology requirements to meet the data traffic needs and schedule are identified. Specific Ka-band technology requirements identified are: transmitters - 0.5 to 200 W with high efficiency; antennas - 5m and 9m diameter, with multiple beams and/or scanning beams; and spacecraft receivers - noise figure of 2 dB. For each component, the current state of technology is assessed and needed technology development programs are identified. It is concluded that to meet the schedules of lunar and Mars precursor missions beginning in approximately the year 2000, aggressive technology development and advanced development programs are required immediately for Ka-band communications systems components. Additionally, the greater data transmission rates for the cargo and piloted phases of the exploration program require further Ka-band communications technology developments targeted for operations beginning in about 2010. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-14954 Delaware Univ., Newark.
CHARGE-SIGN DEPENDENT SOLAR MODULATION OF 1-10 GeV COSMIC RAYS Ph.D. Thesis
Evelyn B. Tuska 1990 315 p
Avail: Univ. Microfilms Order No. DA9120464

Previous experimental observations have indicated a clear variation with the solar cycle in the intensity of the galactic cosmic rays which reach earth. This solar modulation appears to exhibit a dependence on the sign of the cosmic ray particle charge, although to date this dependence has been established and verified (primarily) at energies below 1 GeV/n. A series of measurements of cosmic ray electrons begun in 1968 at the University of Chicago has been conducted by the University of Delaware Bartol Research Institute sine 1984, using the same balloon-borne spectrometer. The MEH experiment on board the International Sun Earth Explorer 3/International Cometary Explorer (ISEE-3/ICE) spacecraft, launched in late 1978, has returned a continuous and highly complementary data set. The balloon data were re-verified using a self-calibration analysis method, and the ISEE-3/ICA MEH detector system was modeled in detail in order to extend the analysis range of those data to include electron energies up to 12 GeV. Through analysis of these two distinct datasets, we have monitored the flux levels of electrons of energies from about 1 to 10 GeV during the time period 1968-1989. Heavy emphasis was placed on the time period 1978-1987, when both LEE and ICE data are available. These data in conjunction with neutron monitor data obtained during the same time period, indicate that the solar modulation of electrons in this rigidity range is remarkably different from that of protons of similar rigidities. Most notably, the electrons reach a much higher flux level during the 1987 solar minimum than during that of 1977, in distinction to protons which typically return to similar flux levels at successive solar minima. No clear understanding of this behavior emerges from current models of the charge-sign dependence of solar modulation. We describe the data analysis methods, present the observations, explore the implications of these observations, and suggest that this apparent lack of symmetry may indicate a dynamical role of cosmic rays in the modulation process. Dissert. Abstr.

N92-14955*# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
THE FLOW OF PLASMA IN THE SOLAR TERRESTRIAL ENVIRONMENT Technical Report, 15 Dec. 1989 - 14 Jun. 1991
Robert W. Schunk 1991 19 p
(Grant NAG5-1484)
(NASA-CR-188812; NAS 1.26:188812) Avail: NTIS HC/MF A03 CSCL 03B

The overall goal of our NASA Theory Program is to study the coupling, time delays, and feedback mechanisms between the various regions of the solar-terrestrial system in a self-consistent, quantitative, manner. To accomplish this goal, it will eventually be

necessary to have time-dependent macroscopic models of the different regions of the solar-terrestrial system and we are continually working toward this goal. However, our immediate emphasis is on the near-earth plasma environment, including the ionosphere, the plasmasphere, and the polar wind. In this area, we have developed unique global models that allow us to study the coupling between the different regions. These results are highlighted. Another important aspect of our NASA Theory Program concerns the effect that localized structure has on the macroscopic flow in the ionosphere, plasmasphere, thermosphere and polar wind. The localized structure can be created by structured magnetospheric inputs (i.e., structured plasma convection, particle precipitation or Birkeland current patterns) or time variations in these inputs due to storms and substorms. Also, some of the plasma flows that we predict with our macroscopic models may be unstable. Another one of our goals is to examine the stability of our predicted flows. Because time-dependent three-dimensional numerical models of the solar-terrestrial environment generally require extensive computer resources, they are usually based on relatively simple mathematical formulations (i.e., simple MHD or hydrodynamic formulations). Therefore, another long-range goal of our NASA Theory Program is to study the conditions under which various mathematical formulations can be applied to specific solar-terrestrial regions. This may involve a detailed comparison of kinetic, semikinetic, and hydrodynamic predictions for a given polar wind scenario or it may involve the comparison of a small-scale particle-in-cell (PIC) simulation of a plasma expansion event with a similar macroscopic expansion event. The different mathematical formulations have different strengths and weaknesses and a careful comparison of model predictions for similar geophysical situations will provide insight into when the various models can be used with confidence. Author

N92-14956*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A THERMAL/NONTHERMAL APPROACH TO SOLAR FLARES
Stephen G. Benka Washington Dec. 1991 109 p
(Grant NGT-50337)
(NASA-TM-4323; Rept-91A02175; NAS 1.15:4323) Avail: NTIS HC/MF A06 CSCL 03B

An approach for modeling solar flare high-energy emissions is developed in which both thermal and nonthermal particles coexist and contribute to the radiation. The thermal/nonthermal distribution function is interpreted physically by postulating the existence of DC sheets in the flare region. The currents then provide both primary plasma heating through Joule dissipation, and runaway electron acceleration. The physics of runaway acceleration is discussed. Several methods are presented for obtaining approximations to the thermal/nonthermal distribution function, both within the current sheets and outside of them. Theoretical hard x ray spectra are calculated, allowing for thermal bremsstrahlung from the heated plasma electrons impinging on the chromosphere. A simple model for hard x ray images of two-ribbon flares is presented. Theoretical microwave gyrosynchrotron spectra are calculated and analyzed, uncovering important new effects caused by the interplay of thermal and nonthermal particles. The theoretical spectra are compared with observed high resolution spectra of solar flares, and excellent agreement is found, in both hard x rays and microwaves. The future detailed application of this approach to solar flares is discussed, as are possible refinements to this theory. Author

N92-14957*# Science Applications International Corp., San Diego, CA.
DETERMINATION OF THE CORONAL MAGNETIC FIELD FROM VECTOR MAGNETOGRAPH DATA Final Report, 15 Nov. 1990 - 14 Dec. 1991
Zoran Mikic 14 Dec. 1991 53 p
(Contract NASw-4571)
(NASA-CR-185477; NAS 1.26:185477; SAIC-91/1298:APPAT-144) Avail: NTIS HC/MF A04 CSCL 03B

A new algorithm was developed, tested, and applied to determine coronal magnetic fields above solar active regions. The coronal field above NOAA active region AR5747 was successfully estimated on 20 Oct. 1989 from data taken at the Mees Solar Observatory of the Univ. of Hawaii. It was shown that observational data can be used to obtain realistic estimates of coronal magnetic fields. The model has significantly extended the realism with which the coronal magnetic field can be inferred from observations. The understanding of coronal phenomena will be greatly advanced by a reliable technique, such as the one presented, for deducing the detailed spatial structure of the coronal field. The payoff from major current and proposed NASA observational efforts is heavily dependent on the success with which the coronal field can be inferred from vector magnetograms. In particular, the present inability to reliably obtain the coronal field has been a major obstacle to the theoretical advancement of solar flare theory and prediction. The results have shown that the evolutional algorithm can be used to estimate coronal magnetic fields. Author

N92-14958*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NASA MARSHALL SPACE FLIGHT CENTER SOLAR OBSERVATORY REPORT, JANUARY - JUNE 1991
James E. Smith 1991 99 p
(NASA-TM-103555; NAS 1.15:103555) Avail: NTIS HC/MF A05 CSCL 03B

Given here is a summary of the solar vector magnetic field, H-alpha, and white-light observations made at the NASA/Marshall Space Flight Center (MSFC) Solar Observatory during its daily periods of operation. The MSFC Solar Observatory facilities consist of the Solar Magnetograph, an f/13, 30-cm Cassegrain system with a 3.5-cm image of the Sun, housed on top of a 12.8-meter tower; a 12.5-cm Razdow H-alpha telescope housed at the base of the tower; an 18-cm Questar telescope with a full aperture white-light filter mounted at the base of the tower; a 30-cm Cassegrain telescope located in a second metal dome; and a 16.5-cm H-alpha telescope mounted on side of the Solar Vector Magnetograph. A concrete block building provides office space, a darkroom for developing film and performing optical testing, a workshop, video displays, and a computer facility for data reduction. Author

N92-14959# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Meteorologische Fernerkundung.
ANISOTROPIC REFLECTION IN MOUNTAINOUS TERRAIN TO DETERMINE THE ABSORPTION OF SOLAR RADIATION FROM SATELLITE DATA
Gerhard H. Ruppersberg and Ruediger H. Buell Oct. 1990 44 p In GERMAN; ENGLISH summary Translation was announced as ESA-TT-1262
(DLR-FB-91-06; ISSN-0939-2963; ETN-92-90326) Avail: NTIS HC/MF A03; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 16.50 DM

The anisotropic factors of quasi three dimensionally modeled areas in the Alps are calculated for two wavelengths in the solar spectral region. For small snow cover, absorptance and radiation budgets are approximated using simple assumptions for the reflectance function of the area's elements. When the snow cover is increased large errors can arise if reflectance anisotropy of the snow fields is not considered adequately. With Meteosat measurements, anisotropic factors are needed that take the effect into consideration. In contrast, fairly accurate absorptances are obtained with the Advanced Very High Resolution Radiometer (AVHRR) data if evaluations are restricted to midday overpasses and positions of the area in the region of nadir +/-273 km.
ESA

N92-14081*# Computer Sciences Corp., Lanham, MD.
EVIDENCE OF CHAOTIC PATTERN IN SOLAR FLUX THROUGH A REPRODUCIBLE SEQUENCE OF PERIOD-DOUBLING-TYPE BIFURCATIONS
S. Ashrafi and L. Roszman *In* NASA. Goddard Space Flight Center, Flight Mechanics/Estimation Theory Symposium, 1991

Oct. 1991 p 189-207 (For primary document see N92-14070 05-13)
Avail: NTIS HC/MF A21 CSCL 22B

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N92-14960# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
COSMIC NEUTRON AND GAMMA QUANTA DETECTION AT BALLOONS
N. N. Volodichev, B. M. Kuzhevskij, O. Yu. Nechaev, M. I. Panasyuk, and P. I. Shavrin 1990 25 p In RUSSIAN
(DE91-638485; NIIYaF-MGU-90-3-149) Avail: NTIS HC/MF A03

The problem of studying neutrons and gamma radiation of cosmic origin at the balloon altitudes is discussed. Neutron sources and gamma-quanta on the Sun are considered. Data on neutron and gamma quantum fluxes in the atmosphere of the Earth are analyzed. Advantages of studying the cosmic radiation using a balloon as compared to satellites are stressed. DOE

N92-14961# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
EMULSION EXPERIMENT FOR STUDY ON ENERGY SPECTRA OF PROTONS AND NUCLEI OF PRIMARY COSMIC RADIATION IN THE ENERGY RANGE GREATER THAN 10 TeV PER PARTICLE
A. Ya. Varkovitskaya, E. A. Zamchalova, V. I. Zatsepin, G. P. Sazhina, and N. V. Sokolskaya 1989 37 p In RUSSIAN
(DE91-625051; NIIYaF-MGU-89-8-85) Avail: NTIS HC/MF A03

Development of the emulsion chamber method to study the energy spectrum of protons and nuclei of primary cosmic radiation is described; the results obtained in long-term exposure of emulsion chambers in the stratospere are presented. DOE

N92-14962# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
STUDY ON COSMIC RAYS WITH THE ENERGY MORE THAN 1 TeV ON SATELLITES BY MEANS OF THE SOKOL DETECTOR
N. L. Grigorev 1989 40 p In RUSSIAN
(DE91-625052; NIIYaF-MGU-89-9-86) Avail: NTIS HC/MF A03

The results of experiments in measuring the energy of charged particles and proton and helium nuclei charges in cosmic rays at 1 TeV energy and higher are presented. Purposes of experiments and ideas on which detector SOKOL is based are presented. The detector includes an ionization calorimeter with 80 scintillation detectors and thin radiators of the Cherenkov counters with light diffusion reflection. The Cherenkov counters give the possibility to separate reliably protons out of the whole cosmic rays flux not influencing particle reverse current into charge detectors. Intensities of helium nuclei and nuclei with Z greater than 5 measured in this paper coincides well with literature data and have a degree factor of integral spectrum (gamma/sub Z)=1.60 + or - 0.08 in the energy region greater than 2 TeV. DOE

99 GENERAL

N92-14963*# National Aeronautics and Space Administration, Washington, DC.
ACCESSING SPACE: A CATALOGUE OF PROCESS, EQUIPMENT AND RESOURCES FOR COMMERCIAL USERS, 1990
Dec. 1990 270 p
(NASA-NP-133; NAS 1.83:133) Avail: NTIS HC/MF A12 CSCL 05B

A catalogue is presented which is intended for commercial developers who are considering, or who have in progress, a project involving the microgravity environment of space or remote sensing of the Earth. An orientation is given to commercial space activities along with a current inventory of equipment, apparatus, carriers, vehicles, resources, and services available from NASA, other government agencies and U.S. industry. The information describes the array of resources that commercial users should consider when planning ground or space based developments. Many items listed have flown in space or been tested in labs and aboard aircraft and can be reused, revitalized, or adapted to suit specific requirements. New commercial ventures are encouraged to exploit existing inventory and expertise to the greatest extent possible.
Author

N92-14964# Purdue Univ., West Lafayette, IN. School of Electrical Engineering.
ANNUAL RESEARCH SUMMARY, 1 JULY 1990 TO 30 JUNE 1991
1991 284 p
Avail: NTIS HC/MF A13

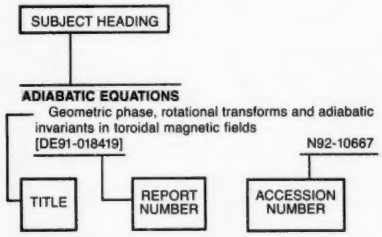
An overview is presented of the research activities of the faculty members of Purdue University's School of Electrical Engineering. Part 1 consists of summaries of current research projects; Part 2 provides description of the facilities of the School; and Part 3 provides information about faculty publications, degree recipients, research centers, funded programs, and corporate donors. Part 4 provided an index by key word and by name. The research was divided into areas such as automatic control, bioengineering, circuit theory, communications and signal processing, computer engineering, energy sources and systems, electromagnetic fields, solid state devices and materials, and engineering education.
Author

N92-14965*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE 1990 JOHNSON SPACE CENTER BIBLIOGRAPHY OF SCIENTIFIC AND TECHNICAL PAPERS
Dec. 1991 101 p
(NASA-TM-104746; S-666; NAS 1.15:104746) Avail: NTIS HC/MF A06 CSCL 05H

Abstracts are presented of scientific and technical papers written and/or presented by L. B. Johnson Space Center (JSC) authors, including civil servants, contractors, and grantees, during the calendar year of 1990. Citations include conference and symposium presentations, papers published in proceedings or other collective works, seminars, and workshop results, NASA formal report series (including contractually required final reports), and articles published in professional journals. Author

N92-13989# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
STRUCTURAL MECHANICS AND MATERIALS SCIENCE
R. C. Tennyson, J. S. Hansen, W. G. Elliott, W. J. Unger, B. Blagojevic, M. G. Blum, R. C. Bowser, T. H. Braithwaite, P. G. Cameron, and T. L. C. Chen et al *In its* Activities of the University of Toronto Institute for Aerospace Studies 1989 p 103-105 (For primary document see N92-13975 05-01)
Avail: NTIS HC/MF A06

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus*.

A

ABEL FUNCTION
Comparison of four stable numerical methods for Abel's integral equation N92-13946
ABSORPTANCE
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959
ABSORPTION CROSS SECTIONS
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions
[DE92-000825] N92-14814
ABSORPTION SPECTRA
Blackbody pumped lasers N92-14467
ABSORPTION SPECTROSCOPY
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
ABSTRACTS
JPRS report: Science and technology. USSR: Materials science
[JPRS-UMS-91-008] N92-14143
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-91-006] N92-14439
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-019] N92-14577
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-022] N92-14580
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-023] N92-14581
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-024] N92-14582
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-007] N92-14776
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-006] N92-14777
The 1990 Johnson Space Center bibliography of scientific and technical papers
[NASA-TM-104746] N92-14965
ACCELERATION (PHYSICS)
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield
[NASA-TM-105456] N92-14105
Hypervelocity launch capabilities to over 10 km/s
[DE92-000242] N92-14377
ACCESS CONTROL
Integrating security in a group oriented distributed system
[NASA-CR-189498] N92-14656
ACCUMULATORS
Photocatalysis with large-scale trough collectors N92-14455
Gas Research Institute experience in solar fuel research N92-14473
ACCURACY
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Improved accuracies for satellite tracking N92-14086
Colored noise effects on batch attitude accuracy estimates N92-14093
ACID RAIN
Regional analysis of S emission-deposition trends in North America from 1979 through 1988
[DE91-018545] N92-14489
ACOUSTIC ATTENUATION
Theoretical models for duct acoustic propagation and radiation N92-14782
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794
ACOUSTIC DUCTS
Theoretical models for duct acoustic propagation and radiation N92-14782
Design and performance of duct acoustic treatment N92-14783
ACOUSTIC EMISSION
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS
[DE91-018827] N92-14395
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
Acoustic emission
[DE91-642293] N92-14796
ACOUSTIC EXCITATION
On the mechanism of turbulence suppression in free shear flows under acoustic excitation
[NASA-TM-105360] N92-14003
ACOUSTIC MEASUREMENT
Acoustic emission
[DE91-642293] N92-14796
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797
ACOUSTIC PROPAGATION
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Theoretical models for duct acoustic propagation and radiation N92-14782
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794
ACOUSTICS
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
Modeling nonlinear acoustical blast waves outdoors: A research summary
[AD-A241030] N92-14792
ACTIVATION
Photchemistry of intermolecular C-H bond activation reactions
[DE91-018967] N92-14130
ACTIVE CONTROL
Bandwidth-limited robust nonlinear spacecraft control N92-14100
Hydraulic actuator system for rotor control N92-14363
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
Active vibration damping of flexible structure
[ESA-TT-1217] N92-14438
ACTIVE GALACTIC NUCLEI
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939
ACTUATORS
Hydraulic actuator system for rotor control N92-14363
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864
ADA (PROGRAMMING LANGUAGE)
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development
[AD-A241695] N92-14661
ADAPTIVE CONTROL
Adaptive PD+ control of rigid robot manipulators
[MEMO-958] N92-14692
Adaptive optical processor
[AD-A241535] N92-14837
ADAPTIVE FILTERS
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390
ADDITIVES
Photocatalyzed removal of multiple contaminants from water N92-14453
ADHESION
Applications of energetic particles in improving coating adhesion properties N92-14461
ADHESIVE BONDING
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
ADIABATIC CONDITIONS
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342
ADIRONDACK MOUNTAINS (NY)
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
ADVECTION
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
AEROACOUSTICS
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975

Aeroacoustics N92-13976
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Jet noise suppression N92-14784
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797

AEROASSIST
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

AEROCAPTURE
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

AERODYNAMIC CHARACTERISTICS
Design of transonic compressor cascades using hodograph method N92-13973

AERODYNAMIC COEFFICIENTS
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084

AERODYNAMIC CONFIGURATIONS
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954

AERODYNAMIC DRAG
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997

AERODYNAMIC FORCES
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366

AERODYNAMIC HEATING
Performance analysis of advanced spacecraft TPS
[NASA-CR-188694] N92-14098

AERODYNAMIC NOISE
Flyover-noise measurement and prediction N92-14786
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795

AERODYNAMIC STABILITY
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364

AERODYNAMICS
Review of aerodynamic design in the Netherlands N92-13929
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Recent progress in inverse methods in France N92-13938
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974
International aviation (selected articles)
[AD-A241119] N92-13993
JPRS report: Science and technology. USSR: Space
[JPRS-USP-91-007] N92-14101

AEROELASTICITY
International aviation (selected articles)
[AD-A241119] N92-13993

AERONAUTICAL ENGINEERING
International aviation (selected articles)
[AD-A241119] N92-13993
Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] N92-14397

AEROSOLS
Shock waves, implosions and dusty gases N92-13986
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126
Particle chemistry impactor experiment N92-14517
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
Airborne aerosol lidar N92-14519

AEROSPACE ENGINEERING
JPRS report: Science and technology. USSR: Space
[JPRS-USP-91-007] N92-14101
Software product assurance requirements for ESA space systems
[ESA-PSS-01-21-ISSUE-2] N92-14631
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
NASA Spinoff, 1990
[NASA-NP-138] N92-14930
Spinoff, 1989
[NASA-TM-105112] N92-14931
Spinoff, 1988
[NASA-TM-105111] N92-14932

AEROSPACE ENVIRONMENTS
Custom microcircuits N92-14775
Accessing space: A catalogue of process, equipment and resources for commercial users, 1990
[NASA-NP-133] N92-14963

AEROSPACE MEDICINE
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586

AEROSPACE PLANES
Rapid near-optimal aerospace plane trajectory generation and guidance
[NASA-CR-189469] N92-14066
History of EPOS air-launched spaceplane project N92-14103

AEROSPACE TECHNOLOGY TRANSFER
NASA Spinoff, 1990
[NASA-NP-138] N92-14930
Spinoff, 1989
[NASA-TM-105112] N92-14931
Spinoff, 1988
[NASA-TM-105111] N92-14932

AEROTHERMODYNAMICS
Performance analysis of advanced spacecraft TPS
[NASA-CR-188694] N92-14098

AGRICULTURE
Isotopes in everyday life
[DE91-642281] N92-14820

AIR
Turbulence measurements in axisymmetric jets of air and helium N92-14299

AIR DEFENSE
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Avionics standardization in the USAF: 1980 to 1990 N92-14048

AIR INTAKES
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002

AIR JETS
Turbulence measurements in axisymmetric jets of air and helium N92-14299

AIR LAUNCHING
History of EPOS air-launched spaceplane project N92-14103

AIR POLLUTION
SNL initiatives in electronic fluxless soldering
[DE92-000818] N92-14188
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494

AIR QUALITY
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487

AIR SAMPLING
Ames ER-2 ozone measurements N92-14512
Whole air sampler N92-14513
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
Mission and sampling analyses for atmospheric satellite experiments N92-14554

AIR TRAFFIC
Terminal area forecasts: FY 1991-2005
[AD-A241489] N92-14005
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034

AIR TRAFFIC CONTROL
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990
[PB91-910405] N92-14006
Electronic systems in transportation
[TP-9983] N92-14009
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025
A Taxi And Ramp Management And Control system (TARMAC) N92-14027
A unique approach to aircraft conflict resolution using artificial intelligence techniques N92-14029
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270

AIR TRANSPORTATION
Terminal area forecasts: FY 1991-2005
[AD-A241489] N92-14005
Electronic systems in transportation
[TP-9983] N92-14009

AIRBORNE EQUIPMENT
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
Theoretical modelling and meteorological analysis for the AASE mission N92-14542

AIRBORNE LASERS
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564

AIRBORNE/SPACEBORNE COMPUTERS
International aviation (selected articles)
[AD-A241119] N92-13993
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664
Advanced computing N92-14774

AIRCRAFT ACCIDENT INVESTIGATION
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990
[PB91-910405] N92-14006

AIRCRAFT ACCIDENTS
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990
[PB91-910405] N92-14006

AIRCRAFT ANTENNAS
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263

AIRCRAFT APPROACH SPACING
A Taxi And Ramp Management And Control system (TARMAC) N92-14027
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034

AIRCRAFT COMPARTMENTS
Interior noise N92-14785

AIRCRAFT CONFIGURATIONS
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
On a global aerodynamic optimization of a civil transport aircraft N92-13931
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948

AIRCRAFT CONSTRUCTION MATERIALS
Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] N92-14042
The two-bay crack problem in fuselages built in GLARE and ARALL
[LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045

AIRCRAFT CONTROL
Electronic systems in transportation
[TP-9983] N92-14009

Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674

AIRCRAFT DESIGN
Review of aerodynamic design in the Netherlands N92-13929
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
Research on inverse methods and optimization in Italy N92-13956
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
An inverse method with regularity condition for transonic airfoil design N92-13969
China aviation journal (selected article) [AD-A240985] N92-13990
Analysis and design of planar and non-planar wings for induced drag minimization [NASA-CR-189509] N92-13999
Avionics technology beyond 2000 N92-14058
Numerical investigations in three-dimensional internal flows [NASA-CR-189467] N92-14313
Design and performance of duct acoustic treatment N92-14783
Quiet aircraft design and operational characteristics N92-14787

AIRCRAFT ENGINES
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424

AIRCRAFT GUIDANCE
DME growth elements and their use with MLS N92-14018
A unique approach to aircraft conflict resolution using artificial intelligence techniques N92-14029
Image-based ranging and guidance for rotorcraft [NASA-CR-184829] N92-14036
Rapid near-optimal aerospace plane trajectory generation and guidance [NASA-CR-189469] N92-14066

AIRCRAFT HAZARDS
LEWICE/E: An Euler based ice accretion code [NASA-TM-105389] N92-14001

AIRCRAFT INDUSTRY
International aviation (selected article) [AD-A240986] N92-13991
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] N92-14382

AIRCRAFT LANDING
A Taxi And Ramp Management And Control system (TARMAC) N92-14027

AIRCRAFT MAINTENANCE
Avionics modernization/upgrades in the late 1990s N92-14055
Fatigue of repaired composite structures N92-14411
Methodology for assessment of skin repairs on Airbus aircraft N92-14428

AIRCRAFT MODELS
SATCOM antenna siting study on P-3C aircraft, volume 2 [NASA-CR-189515] N92-14263

AIRCRAFT NOISE
Physiological response of birds to approaching aircraft [DOT/FAA/CT-91/14] N92-14008
Human response to aircraft noise N92-14780
Interior noise N92-14785
Flyover-noise measurement and prediction N92-14786
Propeller-driven-small airplane noise certification [LR-650] N92-14798

AIRCRAFT SAFETY
Lightning protection requirements for aircraft: A proposed specification [RAE-TM-FS(F)-632-REV-ISSUE-1] N92-14007
Pyrofuze aircraft ordnance arming system [AD-D015024] N92-14040

AIRCRAFT STABILITY
Flight research N92-13981

AIRCRAFT STRUCTURES
Mechanical qualification tests for materials used in the fabrication of aircraft parts [CEAT-M5-5443/01] N92-14042

AIRCRAFT WAKES
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994

AIRFIELD SURFACE MOVEMENTS
Electronic systems in transportation [TP-9983] N92-14009
A Taxi And Ramp Management And Control system (TARMAC) N92-14027

AIRFOIL PROFILES
Review of aerodynamic design in the Netherlands N92-13929
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
Airfoil optimization with efficient gradient calculations N92-13960
Design optimization of transonic airfoils N92-13961

AIRFOILS
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
Study of a new airfoil used in reversible axial fans N92-13970
Aerodynamics N92-13977
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils [NASA-TM-105234] N92-14179
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391

AIRLINE OPERATIONS
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990 [PB91-910405] N92-14006
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025
Quiet aircraft design and operational characteristics N92-14787

AIRPORT SECURITY
Automated baggage threat detection N92-14032

AIRPORTS
Electronic systems in transportation [TP-9983] N92-14009
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025

AIRSPACE
Operational survey: VFR heliport approaches and departures [SCT-91RR-26] N92-14033

ALCOHOLS
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations [DE92-000402] N92-14185

ALGAE
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478

ALGEBRA
Levationis Laus [ITLI-CT-91-08] N92-14622
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators [DE91-635999] N92-14702
Fourier transformation in an algebra of generalized functions [MEMO-954] N92-14730
Idempotents [CWI-AM-R9101] N92-14741
The algebra of Killing vectors in five-dimensional space [DE91-635976] N92-14765
Education stimulation project COO for A30-CT [REPT-90-87] N92-14893

ALGORITHMS
Optimal design of solidification processes N92-13944
Comparison of four stable numerical methods for Abel's integral equation N92-13946
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
Adjoint operator approach to shape design for internal incompressible flows N92-13957
Inverse problems in diffraction N92-13971
Automated problem resolution prototype in automated en route air traffic control N92-14028
A unique approach to aircraft conflict resolution using artificial intelligence techniques N92-14029
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030
Image-based ranging and guidance for rotorcraft [NASA-CR-184829] N92-14036
Rapid near-optimal aerospace plane trajectory generation and guidance [NASA-CR-189469] N92-14066
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
New quests for better attitudes N92-14077
COBE experience with filter QUEST N92-14078
COBE ground segment gyro calibration N92-14080
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline [NASA-CR-189510] N92-14134
A comparison of the fractal and JPEG algorithms N92-14240
Mark 4A antenna control system data handling architecture study N92-14247
Rational approximations to fluid properties [DE90-012531] N92-14297
The matching of doubly ambiguous stereograms [AD-A241251] N92-14587
Analysis of objects in binary images [NASA-CR-4420] N92-14598
Enhancement of surface definition and gridding in the EAGLE code [NASA-CR-189445] N92-14607
Improved selection in totally monotone arrays [DE92-000817] N92-14610
Some practical universal noiseless coding techniques, part 3, module PSI14,K+ [NASA-CR-188718] N92-14611
Two-dimensional adaptive enhancement and detection of linear features in noisy images [DE92-000982] N92-14613
A last-fit greedy coloring algorithm for interval graphs [MEMO-961] N92-14615
A hyperelliptic diophantine equation related to imaginary quadratic number fields with class number 2 [MEMO-978] N92-14617
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints [MEMO-INF-91-43] N92-14619
A randomized algorithm for two-process wait-free test-and-set [ITLI-CT-91-10] N92-14623
Practical computational complexity [RSRE-MEMO-4468] N92-14628
Increasing the efficiency of an algorithm for solving the problem M(Y,G) [MEMO-922] N92-14632
Joining distributed complex objects: Definition and performance [MEMO-INF-91-35] N92-14633
Focusing based on the structure of a model-based diagnosis [MEMO-INF-91-41] N92-14634
Symbolic execution of LOTOS specifications [MEMO-INF-91-47] N92-14637
A CSG scanline algorithm for quadrics [REPT-90-90] N92-14645
Algorithms for the correct implementation of scheduling policies in distributed systems [REPT-90-91] N92-14646
A comparison of some quick algorithms for robust regression [REPT-90-92] N92-14647
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning [NASA-TM-105214] N92-14649
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention [MEMO-INF-91-55] N92-14665
Network orientation [RUU-CS-91-8] N92-14667
Converting a commercial electric direct-drive robot to operate from joint torque commands [DE92-000611] N92-14687
Super-optimization of four-block problems via the equalizer principle [MEMO-957] N92-14691
A note on maximal spanning tree games and Prim's algorithm [MEMO-968] N92-14717
Induced circuits in planar graphs [CWI-BS-R9106] N92-14744

Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769
Advanced computing N92-14774
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833
Field calculation algorithm for general beam distributions
[DE92-002017] N92-14836
Empirical population synthesis: New directions N92-14938
Determination of the coronal magnetic field from vector magnetograph data
[NASA-CR-185477] N92-14957

ALLOCATIONS
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2
[S-HRG-102-113-PT-2] N92-14926
National Aeronautics and Space Administration N92-14927

ALPHA PARTICLES
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496

ALPS MOUNTAINS (EUROPE)
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959

ALTERNATING CURRENT
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284

ALTITUDE
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033
Infrared measurements of atmospheric constituents N92-14501
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers
[DE91-635168] N92-14556

ALUMINUM
Database on fatigue of welded aluminium components ALUFAT N92-14399
Static and dynamic strength of joints in ARALL-laminates N92-14423

ALUMINUM ALLOYS
The two-bay crack problem in fuselages built in GLARE and ARALL
[LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045
Electrochemical noise measurement technique for the determination of aluminum alloy pit initiation rates
[AD-D015050] N92-14144
Grain boundary fracture and alloy design of intermetallics
[DE91-018253] N92-14145
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys
[DE92-000900] N92-14149
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Mechanical properties of PM aluminium alloys N92-14402
Influence of porosity on fatigue behaviour of cast aluminium alloys N92-14403
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410

ALUMINUM SILICATES
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138

ALUMINUM-LITHIUM ALLOYS
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures
[DE92-000903] N92-14150
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material
[DE92-000927] N92-14152

AMORPHOUS MATERIALS
Characterization of magneto-optical media N92-14903
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907

AMPLITUDES
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557

AMPTE (SATELLITES)
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849

ANGULAR MOMENTUM
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702

ANGULAR VELOCITY
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858

ANISOTROPY
Anisotropic space-time
[DE91-636032] N92-14811
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959

ANNEALING
Surface modification technologies using concentrated solar radiation N92-14463
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867

ANNUAL VARIATIONS
Regional analysis of S emission-deposition trends in North America from 1979 through 1988
[DE91-018545] N92-14489
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508

ANTARCTIC REGIONS
Studies of stratospheric particulates N92-14540
Antarctic news clips, 1991
[NSF-91-79] N92-14561

ANTENNA ARRAYS
The effect of error tolerances on MLS array antenna N92-14014
MLS testing using built-in test N92-14024
A minimalist approach to receiver architecture N92-14241
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378

ANTENNA COMPONENTS
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261

ANTENNA DESIGN
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378

ANTENNA RADIATION PATTERNS
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263
Ground wave propagation of a video pulse source, part 2
[DE92-001794] N92-14264
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265

ANTENNAS
Factory acceptance test range N92-14016
Mark 4A antenna control system data handling architecture study N92-14247
Expected antenna utilization and overload N92-14248
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265

ANTIFRICTION BEARINGS
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371

ANTIPARTICLES
Antiparticles
[DE91-636031] N92-14810
Discrete anti-gravity
[DE91-011756] N92-14878

ANTIPROTONS
New parametrization of multiplicity distribution in pp and p(-p) inelastic interactions
[DE91-637100] N92-14805

APERTURES
Practical design considerations and performance characteristics of high numerical aperture holographic lenses N92-14914

APPLICATION SPECIFIC INTEGRATED CIRCUITS
Video data compression using artificial neural network differential vector quantization N92-14214
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
Custom microcircuits N92-14775

APPLICATIONS PROGRAMS (COMPUTERS)
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385
Airfoil Vibration Dampers program
[NASA-CR-188929] N92-14391
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory
[AD-A241692] N92-14658
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 3, task 1: Digital emulation technology laboratory
[AD-A241693] N92-14659

APPROACH CONTROL
DME growth elements and their use with MLS N92-14018
A Taxi And Ramp Management And Control system (TARMAC) N92-14027
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034

APPROPRIATIONS
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
National Aeronautics and Space Administration N92-14921
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
National Aeronautics and Space Administration N92-14923
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924

National Aeronautics and Space Administration N92-14925
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2
[S-HRG-102-113-PT-2] N92-14926
National Aeronautics and Space Administration N92-14927
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933

APPROXIMATION
Design optimization of transonic airfoils N92-13961
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
Rational approximations to fluid properties
[DE90-012531] N92-14297
On a doubly degenerate equation arising in fresh-salt water flow with pumping
[REPT-91-30] N92-14324
On approximation and interpolation of convex functions
[MEMO-967] N92-14716
Further results in the triangular decoupling problem for nonlinear systems
[MEMO-941] N92-14724
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829

ARC JET ENGINES
High-power hydrogen arcjet performance
[NASA-TM-105143] N92-14109

ARC LAMPS
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464

ARCHITECTURE (COMPUTERS)
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Mixed approach towards modular avionics conflicting requirements N92-14051
Avionics software evolution N92-14052
Avionics technology beyond 2000 N92-14058
On-board processing architectures for satellite B-ISDN services N92-14203
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205
Architecture for Survivable System Processing (ASSP) N92-14210
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
Mark 4A antenna control system data handling architecture study N92-14247
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673
Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674
Vision systems for guidance and control: A tutorial overview N92-14679
Advance neural network architectures for guidance and control N92-14682
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695

ARCTIC REGIONS
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
DC-8 mission planning N92-14521
Studies of stratospheric particulates N92-14540
Theoretical modelling and meteorological analysis for the AASE mission N92-14542
SMM mesospheric ozone measurements N92-14550
Arctic Research of the United States, Volume 5 N92-14562

ARMED FORCES (UNITED STATES)
Avionics standardization in the USAF: 1980 to 1990 N92-14048

ARRAYS
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619

ARTERIES
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585

ARTIFICIAL CLOUDS
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764

ARTIFICIAL INTELLIGENCE
Space robotics N92-13987
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671
Intelligent Robotic Systems Study (IRSS), phase 4
[NASA-CR-184262] N92-14672
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685
Discrete event simulation in an artificial intelligence environment: Some examples
[DE92-000218] N92-14686
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700

ARTIFICIAL SATELLITES
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
Satellite remote sensing of large scale ocean transients
[AD-A241122] N92-14574

ASPECT RATIO
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996

ASSIMILATION
Stratospheric Data Analysis System (STRATAN) N92-14539

ASSOCIATIVE PROCESSING (COMPUTERS)
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695

ASTRONOMICAL CATALOGS
Improved accuracies for satellite tracking N92-14086

ASTRONOMICAL MODELS
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe
[DE91-634422] N92-14940
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

ASTROPHYSICS
Antarctic news clips, 1991
[NSF-91-79] N92-14561
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944

ASYMPTOTES
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761

ASYMPTOTIC METHODS
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757

ASYMPTOTIC SERIES
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759

ATLANTIC OCEAN
Satellite remote sensing of large scale ocean transients
[AD-A241122] N92-14574

ATMOSPHERIC BOUNDARY LAYER
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570

ATMOSPHERIC CHEMISTRY
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
The ER-2 meteorological measurement system N92-14510
Whole air sampler N92-14513
DC-8 mission planning N92-14521
Measurement of the absolute solar UV irradiance and variability N92-14522
Upper atmosphere research: Reaction rate and optical measurements N92-14525
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Stratospheric chemistry and transport N92-14536
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538
Stratospheric Data Analysis System (STRATAN) N92-14539
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
Analysis of observations of the middle atmosphere from satellites N92-14545
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

ATMOSPHERIC CIRCULATION
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
The stratospheric residual circulation as deduced from satellite data N92-14498
Stratosphere-troposphere exchange project management N92-14515
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Stratospheric dynamics and transport studies N92-14535
Stratospheric chemistry and transport N92-14536
Stratospheric dynamics N92-14537
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538
Upper atmosphere dynamics N92-14544
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Data analysis and archival N92-14551
Analysis of troposphere-stratosphere exchange N92-14552
A new process by which the general circulation system is maintained
[DE91-635154] N92-14567
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572

ATMOSPHERIC COMPOSITION
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502

Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Measurement of the solar UV flux in the stratosphere N92-14504
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Particle chemistry impactor experiment N92-14517
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
Balloon-borne measurements of polar stratospheric ozone N92-14524
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Laboratory spectroscopy in support of atmospheric measurements N92-14528
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531
Analysis of atmospheric spectra for trace gases N92-14532
Fast two-dimensional model N92-14534
Studies of stratospheric particulates N92-14540
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
Upper atmosphere dynamics N92-14544
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
SMM mesospheric ozone measurements N92-14550
Analysis of troposphere-stratosphere exchange N92-14552
Upper Atmosphere Data Program (UADP) N92-14553
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

ATMOSPHERIC EFFECTS
GPS: Satellite orbits and atmospheric effects
[REPT-91-1] N92-14097
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259

ATMOSPHERIC ENTRY
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085

ATMOSPHERIC GENERAL CIRCULATION MODELS
Stratospheric dynamics and transport studies N92-14535
Stratospheric chemistry and transport N92-14536
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538

ATMOSPHERIC HEATING
Radiative flux measurements in the stratosphere N92-14514
High resolution spectroscopy to support atmospheric measurements N92-14529
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

ATMOSPHERIC MODELS
Regional analysis of S emission-deposition trends in North America from 1979 through 1988
[DE91-018545] N92-14489
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
The stratospheric residual circulation as deduced from satellite data N92-14498
Upper atmosphere research: Reaction rate and optical measurements N92-14525
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Stratospheric dynamics N92-14537
Climatological stratospheric modeling N92-14543
Analysis of troposphere-stratosphere exchange N92-14552
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
A new process by which the general circulation system is maintained
[DE91-635154] N92-14567
An analytical model for climatic predictions
[DE91-635156] N92-14568
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

ATMOSPHERIC MOISTURE
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565

ATMOSPHERIC OPTICS
Upper atmosphere research: Reaction rate and optical measurements N92-14525

ATMOSPHERIC PHYSICS
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
The ER-2 meteorological measurement system N92-14510
Stratospheric dynamics N92-14537
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764

ATMOSPHERIC PRESSURE
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563

ATMOSPHERIC RADIATION
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493

ATMOSPHERIC SOUNDING
Rocket temperature soundings N92-14523
Upper Atmosphere Data Program (UADP) N92-14553
Mission and sampling analyses for atmospheric satellite experiments N92-14554
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563

ATMOSPHERIC STRATIFICATION
Infrared measurements of atmospheric constituents N92-14501

ATMOSPHERIC TEMPERATURE
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259
On the theory of polar ozone holes
[DE91-635165] N92-14486
Rocket temperature soundings N92-14523
Analysis of atmospheric spectra for trace gases N92-14532
Fast two-dimensional model N92-14534
Climatological stratospheric modeling N92-14543
Estimating stratospheric temperature trends using satellite microwave radiances N92-14546
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
Analysis of troposphere-stratosphere exchange N92-14552
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
A new process by which the general circulation system is maintained
[DE91-635154] N92-14567
An analytical model for climatic predictions
[DE91-635156] N92-14568
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570

ATMOSPHERIC TURBULENCE
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570

ATOMIC COLLISIONS
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802

ATOMIC EXCITATIONS
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802

ATOMIC PHYSICS
Program complex for problems of atomic physics, part 3
[DE91-636263] N92-14812

ATOMIC STRUCTURE
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816

ATOMIZING
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126

ATOMS
Program complex for problems of atomic physics, part 3
[DE91-636263] N92-14812

ATTENUATION
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841

ATTITUDE (INCLINATION)
Flight Mechanics/Estimation Theory Symposium, 1991
[NASA-CP-3123] N92-14070
COBE experience with filter QUEST N92-14078
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
Colored noise effects on batch attitude accuracy estimates N92-14093

ATTITUDE CONTROL
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090
Small solar sail spacecraft for Regatta project N92-14102

ATTITUDE INDICATORS
COBE ground segment attitude determination N92-14079
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090

ATTITUDE STABILITY
Small solar sail spacecraft for Regatta project N92-14102

AUDITORY PERCEPTION
Human response to aircraft noise N92-12780

AUGER SPECTROSCOPY
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] N92-14141

AUTOCORRELATION
Two-dimensional adaptive enhancement and detection of linear features in noisy images
[DE92-000982] N92-14613

AUTOMATA THEORY
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254
AUTOMATED EN ROUTE ATC
Automated problem resolution prototype in automated en route air traffic control N92-14028
AUTOMATED RADAR TERMINAL SYSTEM
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034
AUTOMATIC CONTROL
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems
[AD-A241160] N92-14384
AUTOMATIC TEST EQUIPMENT
Testing MLS DME/P transponders and interrogators N92-14020
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
AUTONOMOUS NAVIGATION
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
AUTOREGRESSIVE PROCESSES
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
AVALANCHE DIODES
Electrical power supply for short term power interruptions
[AD-D014998] N92-14281
AVIONICS
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Avionics standardization in the USAF: 1980 to 1990 N92-14048
Historical perspective on the evolution of avionics standards N92-14049
Avionics standardization in Europe N92-14050
Mixed approach towards modular avionics conflicting requirements N92-14051
Avionics software evolution N92-14052
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment N92-14054
Avionics modernization/upgrades in the late 1990s N92-14055
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056
Implications of interoperability and standardization for the industrial base N92-14057
Avionics technology beyond 2000 N92-14058
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087
Architecture for Survivable System Processing (ASSP) N92-14210
AXIAL FLOW
Study of a new airfoil used in reversible axial fans N92-13970
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337
AXIOMS
Weak equivalence for constraint sets
[ITLI-CT-91-05] N92-14621
AXISYMMETRIC BODIES
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
AXISYMMETRIC FLOW
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
Turbulence measurements in axisymmetric jets of air and helium N92-14299

B

B-52 AIRCRAFT
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590
BACKGROUND NOISE
Measurements at the coil B604
[DIGEL-1991-4] N92-14296
BACKGROUND RADIATION
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080
BACKWARD FACING STEPS
An experimental investigation of the separating/reattaching flow over a backstep
[NASA-CR-189495] N92-14314
BACTERIA
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
BAFFLES
Muffler for air powered turbine drive
[AD-D015034] N92-14062
BAGGAGE
Automated baggage threat detection N92-14032
BALANCING
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
BALLOON SOUNDING
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
BALLOON-BORNE INSTRUMENTS
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960
BAND STRUCTURE OF SOLIDS
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
BANDWIDTH
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
Scaling properties of band random matrices
[DE91-635977] N92-14705
BARIUM
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
BARIUM OXIDES
Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x)
[DE92-000898] N92-14873
BARRIER LAYERS
Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182
BARYONS
Basic procedure of measuring the relativistic length and its modifications
[DE91-628072] N92-14260
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
BATCH PROCESSING
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751
BAYES THEOREM
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
BCH CODES
Flexible High Speed Codec (FHSC) N92-14230
BEAM CURRENTS
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833
BEAM INJECTION
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Current generation by neutral beam injection in a non-circular tokamak
[DE91-636816] N92-14848
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
BEAM INTERACTIONS
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830
Dynamical chaos and beam-beam models
[DE91-639002] N92-14831
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
Field calculation algorithm for general beam distributions
[DE92-002017] N92-14836
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
BEAM WAVEGUIDES
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
BEAMS (RADIATION)
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830
Dynamical chaos and beam-beam models
[DE91-639002] N92-14831
BEAMS (SUPPORTS)
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385
BEARINGS
Hydraulic actuator system for rotor control N92-14363
BENDING
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
BIBLIOGRAPHIES
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[NASA-CR-189451] N92-14771
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Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
The 1990 Johnson Space Center bibliography of scientific and technical papers
[NASA-TM-104746] N92-14965
BINARY DATA
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620
BINDERS (MATERIALS)
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
BIOCHEMISTRY
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
BIOCONVERSION
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
BIODEGRADABILITY
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176

BIODEGRADATION
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176
BIOLOGICAL EFFECTS
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
BIOLOGICAL MODELS (MATHEMATICS)
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
Intelligent network management and functional cerebellum synthesis N92-14697
BIOMASS
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
BIOREACTORS
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
BIOT NUMBER
Flow boiling with enhancement devices for cold plate coolant channel design
[NASA-CR-189518] N92-14892
BIOTECHNOLOGY
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
BIPOLAR TRANSISTORS
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295
BIRDS
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008
BIREFRINGENCE
White light optical fourier transform device
[AD-D015022] N92-14838
BIRKELAND CURRENTS
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
BISMUTH COMPOUNDS
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
BISMUTH OXIDES
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x)
[DE92-000849] N92-14866
BIT ERROR RATE
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
BIVARIATE ANALYSIS
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
BLACK BODY RADIATION
Blackbody pumped lasers N92-14467
BLACK HOLES (ASTRONOMY)
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937
BLADE SLAP NOISE
The application of experimental data to blade wake interaction noise prediction
[NASA-CR-189461] N92-14789
BLADE TIPS
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
BLADE-VORTEX INTERACTION
The turbomachine blading design using S2-S1 approach N92-13940
BLOOD FLOW
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
BODY-WING AND TAIL CONFIGURATIONS
On a global aerodynamic optimization of a civil transport aircraft N92-13931
BODY-WING CONFIGURATIONS
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
BOILING
Flow boiling with enhancement devices for cold plate coolant channel design
[NASA-CR-189518] N92-14892
BOMBS (ORDNANCE)
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
BONDING
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline
[NASA-CR-189510] N92-14134
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422
BOOLEAN ALGEBRA
A framework for test selection
[MEMO-INF-91-54] N92-14753
BORDERS
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907
BORIDES
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
BORN APPROXIMATION
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834
BORN-INFELD THEORY
Fedorov universal equations in the string and membrane theories
[DE91-628073] N92-14889
BORON
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
BORON NITRIDES
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
BOSONS
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization
[DE91-634069] N92-14704
Z(sup 0) yields hadrons in SDC
[DE92-000294] N92-14800
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813
On topological symmetries and the Goldstone Theorem
[DE91-634058] N92-14880
BOUNDARIES
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
BOUNDARY CONDITIONS
The turbomachine blading design using S2-S1 approach N92-13940
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
A coupled time and frequency approach for nonlinear wave radiation N92-14301
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829
On topological symmetries and the Goldstone Theorem
[DE91-634058] N92-14880
BOUNDARY INTEGRAL METHOD
A boundary integral approach in primitive variables for free surface flows N92-14304
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
BOUNDARY LAYER EQUATIONS
Computational fluid dynamics N92-13979
BOUNDARY LAYER FLOW
Aeroacoustics N92-13976
Parameterization of intermittant turbulence and the vorton method
[DE92-000758] N92-14317
BOUNDARY LAYER SEPARATION
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
BOUNDARY LAYERS
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063
An experimental investigation of the separating/reattaching flow over a backstep
[NASA-CR-189495] N92-14314
BOUNDARY VALUE PROBLEMS
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
Radiation from a dipole antenna into an inhomogeneous, comprehensible, and nonlinear space-plasma
[DLR-FB-91-05] N92-14269
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
Stoermer-Cowell- and related methods for the numerical solution of second order periodic initial value problems for ODE's. 1: Survey of methods
[MEMO-966] N92-14714
BRAKES (FOR ARRESTING MOTION)
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
BRANCHING (MATHEMATICS)
Separatrix cycles and multiple limit cycles in a class of quadratic systems
[REPT-90-84] N92-14732
BRAYTON CYCLE
Heat pumps for industry
[DE91-015030] N92-14318
BRAZING
Surface modification technologies using concentrated solar radiation N92-14463
BRIDGMAN METHOD
Optimal design of solidification processes N92-13944
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors
[DE92-000893] N92-14876
BROADBAND
A B-ISDN-compatible modem/codec N92-14229
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797
BROADCASTING
On-board congestion control for satellite packet switching networks N92-14228
BROKEN SYMMETRY
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813
On topological symmetries and the Goldstone Theorem
[DE91-634058] N92-14880
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
BROMIDES
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
BROMINE
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
BROMINE COMPOUNDS
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
BUBBLES
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
BUDGETING
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
BUILDINGS
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494

BUMPERS
Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield
[NASA-TM-105456] N92-14105
BUNCHING
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830
BURNING RATE
Nonstationary gasdynamics N92-13985
BUTT JOINTS
Fatigue behaviour of circumferential joints N92-14421

C

C (PROGRAMMING LANGUAGE)
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development
[AD-A241695] N92-14661
C-135 AIRCRAFT
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590
CALCIUM CHLORIDES
Solubility of calcium in CaO-CaCl2
[AWE-0-16/90] N92-14140
CALCIUM ISOTOPES
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
CALCIUM OXIDES
Solubility of calcium in CaO-CaCl2
[AWE-0-16/90] N92-14140
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x)
[DE92-000849] N92-14866
CALIBRATING
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Testing MLS DME/P transponders and interrogators N92-14020
COBE ground segment gyro calibration N92-14080
Study of geopotential error models used in orbit determination error analysis N92-14083
Improved accuracies for satellite tracking N92-14086
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090
Development of a calibration method for deepsea magnetic particle testing N92-14196
Measurements at the coil B604
[DIGEL-1991-4] N92-14296
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942
CALIFORNIUM ISOTOPES
Determination of energy distribution for photon and neutron microdosimetry
[DE91-640663] N92-14819
CAMERAS
Image-based ranging and guidance for rotorcraft
[NASA-CR-184829] N92-14036
Improved accuracies for satellite tracking N92-14086
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
CANADA
TDC: Innovation in transport N92-14010
CANARD CONFIGURATIONS
On a global aerodynamic optimization of a civil transport aircraft N92-13931
CANOPIES (VEGETATION)
Modeling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443
CAPACITANCE
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper
[DE92-000599] N92-14287
CARBON DIOXIDE
Climatological stratospheric modeling N92-14543
CARBON DIOXIDE CONCENTRATION
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
Climatological stratospheric modeling N92-14543
CARBON DIOXIDE LASERS
Neural net sensor fusion
[AD-A241765] N92-14336
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564
CARBON FIBER REINFORCED PLASTICS
Delamination imaging in CFRP laminates N92-14418
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420
CARBON FIBERS
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites
[NASA-TM-105233] N92-14120
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
CARBON ISOTOPES
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
CARBON MONOXIDE
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132
CARBON STEELS
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
CARBONATES
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282
CAROTENE
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477
CARTESIAN COORDINATES
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059
CASCADE FLOW
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
Design of transonic compressor cascades using hodograph method N92-13973
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063
CASSEGRAIN OPTICS
NASA Marshall Space Flight Center solar observatory report, January - June 1991
[NASA-TM-103555] N92-14958
CAST ALLOYS
Influence of porosity on fatigue behaviour of cast aluminium alloys N92-14403
Low cycle fatigue of cast nickel base turbine rotors N92-14405
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
CASTING
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429
CASTINGS
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
CATALOGS (PUBLICATIONS)
Publications of the National Institute of Standards and Technology, 1990 catalog
[PB91-216531] N92-14895
CATALYSIS
Controlled synthesis of polyenes by catalytic methods
[DE91-018804] N92-14113
The puzzles of surface science and recent attempts to explain them
[DE92-000928] N92-14136
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138
Chemical models of advanced oxidation processes N92-14447
CATALYSTS
Immobilized catalysts in solar concentrators N92-14454
CATS
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586
CAUCHY PROBLEM
On a doubly degenerate equation arising in fresh-salt water flow with pumping
[REPT-91-30] N92-14324
CAVITATION FLOW
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
CAVITIES
A receiver design for the superconducting cavity-maser oscillator N92-14238
CAVITY RESONATORS
Photon storage cavities
[DE92-000921] N92-14338
Discrete cavity model of a standing-wave free-electron laser
[DE92-000839] N92-14340
CELLS (BIOLOGY)
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
CENSUS
Census techniques on relativized space classes
[ITLI-CT-91-06] N92-14721
CENTRIFUGAL PUMPS
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362
CERAMIC FIBERS
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
CERAMIC MATRIX COMPOSITES
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
CERAMICS
Performance analysis of advanced spacecraft TPS
[NASA-CR-188694] N92-14098
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior
[DE92-000899] N92-14164
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
Ceramics derived from organo-metallic precursors
[AD-A241849] N92-14172
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
Ceramic regenerator program
[NASA-CR-189053] N92-14374
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865
CEREBELLUM
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
Intelligent network management and functional cerebellum synthesis N92-14697
CEREBRAL CORTEX
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696

CERTIFICATION
Flyover-noise measurement and prediction N92-14786
Propeller-driven-small airplane noise certification [LR-650] N92-14798
CESIUM
Program complex for problems of atomic physics, part 3 [DE91-636263] N92-14812
CESIUM ALLOYS
A novel phase transition in alloys [DE92-000366] N92-14161
CHANGE DETECTION
International global network of fiducial stations: Scientific and implementation issues [NASA-CR-189525] N92-14236
CHANNEL FLOW
Adjoint operator approach to shape design for internal incompressible flows N92-13957
CHAOS
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Dynamical chaos and beam-beam models [DE91-639002] N92-14831
CHAPLYGIN EQUATION
Design of transonic compressor cascades using hodograph method N92-13973
CHARACTERIZATION
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization [AD-A240857] N92-14180
CHARGE CARRIERS
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle [NASA-CR-189090] N92-14436
CHARGE COUPLED DEVICES
Improved accuracies for satellite tracking N92-14086
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205
Solar x ray astronomy rocket program [NASA-CR-183494] N92-14935
CHARGE TRANSFER
Photophysics and photochemistry of porphyrin systems N92-14470
CHARGED PARTICLES
On the electrodynamics of spinning particles [NIKHEF-H/90-22] N92-14822
Proposed research on advanced accelerator concepts [DE92-000824] N92-14850
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
CHARM (PARTICLE PHYSICS)
1/N-expansion in quantum mechanics, part 1 [DE91-635986] N92-14882
CHARPY IMPACT TEST
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels [DE91-018849] N92-14154
CHECKOUT
Factory acceptance test range N92-14016
CHEMICAL ANALYSIS
Study of improved methods for predicting chemical equilibria [DE91-018803] N92-14129
CHEMICAL BONDS
Photchemistry of intermolecular C-H bond activation reactions [DE91-018967] N92-14130
The puzzles of surface science and recent attempts to explain them [DE92-000928] N92-14136
Binding and catalytic reduction of NO by transition metal aluminosilicates [DE92-001657] N92-14138
CHEMICAL CLOUDS
ZEST flight test experiments, Kauai Test Facility, Hawaii [AD-A241143] N92-14764
CHEMICAL COMPOSITION
Segregation in welded nickel-base alloys [DE91-624373] N92-14158
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
CHEMICAL ENGINEERING
Potential industrial applications of photons N92-14471
Fuel processing and thermochemical/photochemical cycles N92-14472
CHEMICAL EQUILIBRIUM
Study of improved methods for predicting chemical equilibria [DE91-018803] N92-14129
CHEMICAL REACTIONS
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data [DE91-018528] N92-14128
Photchemistry of intermolecular C-H bond activation reactions [DE91-018967] N92-14130
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] N92-14326
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
Particle chemistry impactor experiment N92-14517
CHEMICAL REACTORS
Ultrox operating experiences with UV/oxidation; economics N92-14451
Thermochemical energy storage for a lunar base [NASA-TM-105333] N92-14485
CHINA
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
CHIPS (ELECTRONICS)
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper [DE92-000599] N92-14287
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration [AD-A241696] N92-14662
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation [AD-A241697] N92-14663
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development [AD-A241698] N92-14664
Evaluating the operations capability of Freedom's Data Management System [NASA-CR-187315] N92-14894
CHIRAL DYNAMICS
Quarks in the instanton vacuum. 1: Quark propagator [DE91-637129] N92-14806
CHIRP
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
CHLORINE COMPOUNDS
SMM mesospheric ozone measurements N92-14550
CHROMIUM OXIDES
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy [DE92-000734] N92-14155
CHROMIUM STEELS
Study of mechanical behavior and internal structure of ferritic nanocrystalline material [DE92-000760] N92-14162
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
The effect of overloads on life-time N92-14430
CIRCUITS
On-board processing architectures for satellite B-ISDN services N92-14203
Temporal learning in the cerebellum: The microcircuit model [NASA-CR-188873] N92-14668
Induced circuits in planar graphs [CWI-BS-R9106] N92-14744
CIRCULAR ORBITS
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085
CIVIL AVIATION
General aviation activity and avionics survey, calendar year 1989 [PB91-179234] N92-13926
FAA statistical handbook of aviation: Calendar year 1989 [PB91-202051] N92-13927
China aviation journal (selected article) [AD-A240985] N92-13990
CLADDING
Surface modification technologies using concentrated solar radiation N92-14463
CLASSICAL MECHANICS
On the electrodynamics of spinning particles [NIKHEF-H/90-22] N92-14822
Classical and quantum mechanics of a spinning particle interacting with background fields [NIKHEF-H/91-06] N92-14823
Another treatment of the relation between classical and quantum mechanics [DE91-641534] N92-14891
CLASSIFICATIONS
Geographic data modelling in TM [MEMO-INF-91-53] N92-14640
CLEAN ROOMS
Clean room survey and assessment, volume 5, appendix H [NASA-CR-184251] N92-14594
CLEANING
Solvent substitution with non-chlorinated biodegradable solvents [DE91-018708] N92-14176
Preoxidation cleaning optimization for crystalline silicon [DE92-000981] N92-14178
CLEBSCH-GORDAN COEFFICIENTS
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators [DE91-635999] N92-14702
CLIMATE CHANGE
Climatological stratospheric modeling N92-14543
Physical processes responsible for ENSO events [DE91-635166] N92-14569
CLIMATOLOGY
An analytical model for climatic predictions [DE91-635156] N92-14568
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data [NASA-CR-188128] N92-14572
CLIMBING FLIGHT
Operational survey: VFR heliport approaches and departures [SCT-91RR-26] N92-14033
CLOCKS
Anisotropic space-time [DE91-636032] N92-14811
CLOSED ECOLOGICAL SYSTEMS
Initial assessments of life support technology evolution and advanced sensor requirements, volume 2, appendix A [NASA-CR-184248] N92-14591
Advanced instrumentation: Technology database enhancement, volume 4, appendix G [NASA-CR-184250] N92-14593
Advanced life support study [NASA-CR-184247] N92-14595
CLOUD COVER
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth [DLR-FB-91-07] N92-14571
CLOUD PHYSICS
Studies of stratospheric particulates N92-14540
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
CLOUDS
Influences of clouds and rain on the large-scale transport and deposition of sulfur [DE92-000473] N92-14492
Report on the search for atmospheric holes using airs image data [NASA-CR-187902] N92-14943
CLOUDS (METEOROLOGY)
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth [DLR-FB-91-07] N92-14571
CMOS
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper [DE92-000599] N92-14287
COASTAL CURRENTS
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting [KNMI-TR-131] N92-14575
COATING
Applications of energetic particles in improving coating adhesion properties N92-14461
COATINGS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces [NASA-TM-105363] N92-14114
Thermal wave imaging examples and applications [AD-A240982] N92-14124

Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182

COAXIAL CABLES
Transfer impedance of coaxial cables
[DE91-018411] N92-14273

COAXIAL NOZZLES
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112

COBALT
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904

COBALT ISOTOPES
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841

CODE DIVISION MULTIPLE ACCESS
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205

CODERS
Flexible High Speed Codec (FHSC) N92-14230
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
A bi-directional BAUDOT/ASCII code converter
[RSRE-MEMO-4479] N92-14629

CODING
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
A B-ISDN-compatible modem/codec N92-14229
Some partial-unit-memory convolutional codes N92-14243
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal
[RSRE-91014] N92-14624

COEFFICIENTS
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360

COERCIVITY
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907

COHERENT SCATTERING
Anisotropy of relativistic lepton coherent scattering at axial channeling
[DE91-623659] N92-14874

COINCIDENCE CIRCUITS
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497

COLD PLASMAS
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846

COLD ROLLING
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429

COLLECTION
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506

COLLISION PARAMETERS
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816

COLLISIONS
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990
[PB91-910405] N92-14006

COLLOCATION
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

COLOR
Colored noise effects on batch attitude accuracy estimates N92-14093
A last-fit greedy coloring algorithm for interval graphs
[MEMO-961] N92-14615

COLUMNS (SUPPORTS)
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385

COMBAT
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067

COMBINATORIAL ANALYSIS
Combinatorial properties of finite sequences with high Kolomogorov complexity
[ITLI-CT-91-09] N92-14754
The consistency of an extended NaDSet
[ITLI-ML-90-11] N92-14768
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769

COMBUSTION
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975
Combustion and propulsion N92-13978
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133

COMBUSTION PHYSICS
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
Waste treatment N92-14456

COMBUSTION PRODUCTS
Nonstationary gasdynamics N92-13985

COMETS
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943

COMMAND AND CONTROL
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
An example machine used for developing a proof strategy for secure systems
[RSRE-91022] N92-14627

COMMERCIAL AIRCRAFT
China aviation journal (selected article)
[AD-A240985] N92-13990
International aviation (selected article)
[AD-A240986] N92-13991
Quiet aircraft design and operational characteristics N92-14787

COMMUNICATION CABLES
On-board demux/demod N92-14221

COMMUNICATION EQUIPMENT
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953

COMMUNICATION NETWORKS
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
On-board processing architectures for satellite B-ISDN services N92-14203
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
Mobile telephony through LEO satellites: To OBP or not N92-14206
Satellite communications for the next generation telecommunication services and networks N92-14207
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
A reconfigurable multicarrier demodulator architecture N92-14213
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266
Ranging standard. Volume 1: Direct ground to spacecraft ranging
[ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271
Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762

COMMUNICATION SATELLITES
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
Fault-tolerant multichannel demultiplexer subsystems N92-14220
On-board processing for telecommunications satellites N92-14227
On-board congestion control for satellite packet switching networks N92-14228
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262

COMMUNITIES
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791

COMPENSATION
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693

COMPENSATORS
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693

COMPILERS
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657

COMPLETENESS
Weak equivalence for constraint sets
[ITLI-CT-91-05] N92-14621
On the proofs of arithmetical completeness for interpretability logic
[ITLI-ML-91-03] N92-14739

COMPLEX SYSTEMS
Inverse problems in the design, modeling and testing of engineering systems N92-13966

COMPLEXITY
Quasi-injective reductions
[ITLI-CT-91-11] N92-14723

COMPONENT RELIABILITY
FIDEX: An expert system for satellite diagnostics N92-14218

COMPOSITE MATERIALS
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967

COMPOSITE PROPELLANTS
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization
[AD-A240857] N92-14180

COMPOSITE STRUCTURES
Fiber optic smart structures N92-13980
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059
Development of a new design method to predict impact damage tolerance of composite structures N92-14416

COMPRESSIBILITY EFFECTS
Fluid compressibility effects on the dynamic response of hydrostatic journal bearings N92-14372

COMPRESSIBLE FLOW
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356

COMPRESSION RATIO
A comparison of the fractal and JPEG algorithms N92-14240

COMPRESSOR BLADES
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
Blade design and analysis using a modified Euler solver N92-13952

COMPRESSORS
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063

COMPUTATION
Super-optimization of four-block problems via the equalizer principle
[MEMO-957] N92-14691
An improved approach to automatic error cumulation control
[MEMO-INF-91-61] N92-14720

COMPUTATIONAL FLUID DYNAMICS
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975
Aerodynamics N92-13977

Computational fluid dynamics N92-13979
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] N92-14319

COMPUTATIONAL GEOMETRY
A CSG scanline algorithm for quadrics
[REPT-90-90] N92-14645

COMPUTATIONAL GRIDS
Design optimization of transonic airfoils N92-13961
Computational fluid dynamics N92-13979
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
Enhancement of surface definition and gridding in the EAGLE code
[NASA-CR-189445] N92-14607
Shock wave codes at Sandia National Laboratories
[DE91-017847] N92-14612

COMPUTER AIDED DESIGN
Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3)
[NASA-CR-188125] N92-13928
Review of aerodynamic design in the Netherlands N92-13929
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618

COMPUTER AIDED TOMOGRAPHY
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
Comparison of four stable numerical methods for Abel's integral equation N92-13946
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584

COMPUTER ASSISTED INSTRUCTION
Education stimulation project COO for A30-CT
[REPT-90-87] N92-14893

COMPUTER DESIGN
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation
[AD-A241697] N92-14663
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664

COMPUTER GRAPHICS
Mixed approach towards modular avionics conflicting requirements N92-14051
A comparison of the fractal and JPEG algorithms N92-14240
A CSG scanline algorithm for quadrics
[REPT-90-90] N92-14645
Triangle sets in PHIGS PLUS: A valuable link with finite element modeling
[CWI-CS-R9110] N92-14655
Plotter of pole figure using data from x ray diffraction
[DE91-634207] N92-14868

COMPUTER INFORMATION SECURITY
Traceability and conformance in secure systems
[RSRE-91016] N92-14625
Secure refinement
[RSRE-91019] N92-14626
An example machine used for developing a proof strategy for secure systems
[RSRE-91022] N92-14627
Notes on the polyinstantiation problem
[RSRE-MEMO-4504] N92-14630
Integrating security in a group oriented distributed system
[NASA-CR-189498] N92-14656
Lies, damned lies, and databases
[RSRE-MEMO-4503] N92-14917

COMPUTER NETWORKS
Architecture for Survivable System Processing (ASSP) N92-14210
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270
Vision systems for guidance and control: A tutorial overview N92-14679
Discrete event simulation in an artificial intelligence environment: Some examples
[DE92-000218] N92-14686

COMPUTER PROGRAM INTEGRITY
Traceability and conformance in secure systems
[RSRE-91016] N92-14625
Secure refinement
[RSRE-91019] N92-14626
An example machine used for developing a proof strategy for secure systems
[RSRE-91022] N92-14627
Notes on the polyinstantiation problem
[RSRE-MEMO-4504] N92-14630
Lies, damned lies, and databases
[RSRE-MEMO-4503] N92-14917

COMPUTER PROGRAMMING
Practical computational complexity
[RSRE-MEMO-4468] N92-14628
A bi-directional BAUDOT/ASCII code converter
[RSRE-MEMO-4479] N92-14629
Joining distributed complex objects: Definition and performance
[MEMO-INF-91-35] N92-14633
An exercise in protocol synthesis
[MEMO-INF-91-46] N92-14636
Addressing performance requirements in the FDT based design of distributed systems
[MEMO-INF-91-48] N92-14638
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Termination of term rewriting: From many-sorted to one-sorted
[RUU-CS-91-18] N92-14653
A neural network design methodology: Considerations and issues for design and project management N92-14676

COMPUTER PROGRAMS
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
On a global aerodynamic optimization of a civil transport aircraft N92-13931
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943
Hypersonic aerodynamics N92-13983
LEWICE/E: An Euler based ice accretion code
[NASA-TM-105389] N92-14001
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
Automated problem resolution prototype in automated en route air traffic control N92-14028
A unique approach to aircraft conflict resolution using artificial intelligence techniques N92-14029
Mark 4A antenna control system data handling architecture study N92-14247
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
Application of MSC/DYNA to shock and impact problems in aircraft industry
[MBB-UD-0593-91-PUB] N92-14382
A concept for the revisions of structural inspection schedules N92-14431
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
Monitoring sea level rise
[REPT-90-1] N92-14576
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
Enhancement of surface definition and gridding in the EAGLE code
[NASA-CR-189445] N92-14607
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
GAMUT: A computer code for (gamma)-ray energy and intensity analysis
[DE92-000691] N92-14609
Shock wave codes at Sandia National Laboratories
[DE91-017847] N92-14612
CDFTBL: A statistical program for generating cumulative distribution functions from data
[DE92-002106] N92-14614
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
A bi-directional BAUDOT/ASCII code converter
[RSRE-MEMO-4479] N92-14629
Software product assurance requirements for ESA space systems
[ESA-PSS-01-21-ISSUE-2] N92-14631
Case study of a national educational software development program: The Netherlands
[REPT-91-15] N92-14648
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649
Triangle sets in PHIGS PLUS: A valuable link with finite element modeling
[CWI-CS-R9110] N92-14655
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700
Advanced computing N92-14774
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833

COMPUTER SYSTEMS DESIGN
A hard real-time operating system for airborne scientific experiments N92-14031
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266
An engineering approach to ODP systems design
[MEMO-INF-91-49] N92-14600
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration
[AD-A241696] N92-14662

COMPUTER SYSTEMS PERFORMANCE
Design and analysis techniques for MLS safety critical software N92-14017
COBE experience with filter QUEST N92-14078
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270
Traceability and conformance in secure systems
[RSRE-91016] N92-14625
An example machine used for developing a proof strategy for secure systems
[RSRE-91022] N92-14627
Addressing performance requirements in the FDT based design of distributed systems
[MEMO-INF-91-48] N92-14638
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Preliminary basic performance analysis of the Cedar multiprocessor memory system
[NASA-CR-189542] N92-14652
Dynamic action scheduling in a parallel database system
[MEMO-INF-91-58] N92-14666

Evaluating the operations capability of Freedom's Data Management System
[NASA-CR-187315] N92-14894

COMPUTER SYSTEMS PROGRAMS
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal
[RSRE-91014] N92-14624
Standard formatted data units-control authority operations
[NASA-CR-188748] N92-14896
Standard formatted data units-control authority procedures
[NASA-CR-188127] N92-14897

COMPUTER TECHNIQUES
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685

COMPUTER VISION
Radar vision N92-14026
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
Vision systems for guidance and control: A tutorial overview N92-14679

COMPUTERIZED SIMULATION
The effect of error tolerances on MLS array antenna N92-14014
MLS system error model identification and synthesis N92-14015
Mixed approach towards modular avionics conflicting requirements N92-14051
Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
Motion dynamics of submersibles N92-14191
A B-ISDN-compatible modem/codec N92-14229
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances
[MEMO-973] N92-14379
Two-dimensional adaptive enhancement and detection of linear features in noisy images
[DE92-000982] N92-14613
Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671
A model of the self-explanation effect
[AD-A241200] N92-14684
Discrete event simulation in an artificial intelligence environment: Some examples
[DE92-000218] N92-14686
Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Plotter of pole figure using data from x ray diffraction
[DE91-634207] N92-14868

COMPUTERS
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602

COMSAT PROGRAM
COMSAT Laboratories' on-board baseband switch development N92-14225

CONCATENATED CODES
Determinate-state convolutional codes N92-14242

CONCENTRATION (COMPOSITION)
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
Infrared measurements of atmospheric constituents N92-14501
Analysis of atmospheric spectra for trace gases N92-14532

CONCURRENT PROCESSING
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
Definition of reusable concurrent software components
[REPT-90-066] N92-14606
A randomized algorithm for two-process wait-free test-and-set
[ITLI-CT-91-10] N92-14623
A fully abstract model for concurrent constraint programming
[RUU-CS-91-10] N92-14651
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654

CONDENSATION NUCLEI
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564

CONDITIONED REFLEXES
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668

CONDITIONING (LEARNING)
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668

CONDUCTING POLYMERS
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289

CONDUCTIVE HEAT TRANSFER
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944

CONDUCTORS
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846

CONFERENCES
Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3)
[NASA-CR-188125] N92-13928
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990
[NASA-CP-3122] N92-14346
Proceedings of Damping 1991, volume 3
[AD-A241313] N92-14386
Potential Applications of Concentrated Solar Energy
[NAP-S-416] N92-14445
Water treatment: Advanced photooxidation processes N92-14446

CONFORMAL MAPPING
Airfoil optimization with efficient gradient calculations N92-13960
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327

CONGESTION
On-board congestion control for satellite packet switching networks N92-14228

CONGRESSIONAL REPORTS
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
National Aeronautics and Space Administration N92-14921
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
National Aeronautics and Space Administration N92-14923
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924
National Aeronautics and Space Administration N92-14925
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2
[S-HRG-102-113-PT-2] N92-14926
National Aeronautics and Space Administration N92-14927
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933

CONGRUENCES
Idempotents
[CWI-AM-R9101] N92-14741

CONJUGATE GRADIENT METHOD
Optimal design of solidification processes N92-13944
Comparison of four stable numerical methods for Abel's integral equation N92-13946

CONNECTORS
High pressure fiber optic connector plug
[AD-D015033] N92-14839

CONSECUTIVE EVENTS
Combinatorial properties of finite sequences with high Kolomogorov complexity
[ITLI-CT-91-09] N92-14754

CONSERVATION LAWS
Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
Classical theory of a structural point object in the 2nd order approximation
[DE91-628031] N92-14818

CONSTITUTIVE EQUATIONS
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture
[DE91-638175] N92-14389
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434

CONSTRAINTS
Weak equivalence for constraint sets
[ITLI-CT-91-05] N92-14621
A fully abstract model for concurrent constraint programming
[RUU-CS-91-10] N92-14651

CONTACT RESISTANCE
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829

CONTAMINANTS
Effect of light intensity on photocatalytic reaction N92-14449
Photocatalyzed removal of multiple contaminants from water N92-14453
Photocatalysis with large-scale trough collectors N92-14455
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492

CONTAMINATION
Immobilized catalysts in solar concentrators N92-14454
Clean room survey and assessment, volume 5, appendix H
[NASA-CR-184251] N92-14594

CONTINUOUS SPECTRA
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

CONTINUOUS WAVE LASERS
Blackbody pumped lasers N92-14467

CONTOURS
Analysis and design of transonic airfoils using streamwise coordinates N92-13955

CONTRACT MANAGEMENT
Solar thermal energy contract list, fiscal year 1990
[DE91-002175] N92-14481

CONTRAILS
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth
[DLR-FB-91-07] N92-14571

CONTROL SIMULATION
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087

CONTROL SYSTEMS DESIGN
Spacecraft dynamics and control N92-13988
A Taxi And Ramp Management And Control system (TARMAC) N92-14027
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
Mark 4A antenna control system data handling architecture study N92-14247

Hydraulic actuator system for rotor control N92-14363
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS [DE92-000998] N92-14378
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems [AD-A241160] N92-14384
Integrated adaptive filtering and design for control experiments of flexible structures [NASA-CR-188627] N92-14390
Langley's CSI evolutionary model: Phase O [NASA-TM-104165] N92-14394
Intelligent Robotic Systems Study (IRSS), phase 3 [NASA-CR-184261] N92-14671
Intelligent Robotic Systems Study (IRSS), phase 4 [NASA-CR-184262] N92-14672
Vision systems for guidance and control: A tutorial overview N92-14679
Multisensor data fusion as applied to guidance and control N92-14681
Advance neural network architectures for guidance and control N92-14682
Finite-dimensional robust controller designs for distributed parameter systems: A survey [W-9104] N92-14699
Equivalence of nonlinear systems to input-output prime forms [MEMO-975] N92-14752

CONTROL THEORY
Active vibration damping of flexible structure [ESA-TT-1217] N92-14438

CONTROLLERS
COMSAT Laboratories' on-board baseband switch development N92-14225
On-board congestion control for satellite packet switching networks N92-14228
Mark 4A antenna control system data handling architecture study N92-14247
A bi-directional BAUDOT/ASCII code converter [RSRE-MEMO-4479] N92-14629
Intelligent Robotic Systems Study (IRSS), phase 4 [NASA-CR-184262] N92-14672
Finite-dimensional robust controller designs for distributed parameter systems: A survey [W-9104] N92-14699

CONVECTION
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994

CONVECTIVE FLOW
Flow boiling with enhancement devices for cold plate coolant channel design [NASA-CR-189518] N92-14892

CONVECTIVE HEAT TRANSFER
Modelling of the axial-flow gas laser [DE91-635597] N92-14337

CONVERGENCE
Potential reconstruction from R-matrix resonance positions and reduced widths [DE91-628029] N92-14708

CONVERGENT-DIVERGENT NOZZLES
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model [NASA-TM-105338] N92-14795

CONVEXITY
On approximation and interpolation of convex functions [MEMO-967] N92-14716

CONVOLUTION INTEGRALS
Determinate-state convolutional codes N92-14242

COOLANTS
Flow boiling with enhancement devices for cold plate coolant channel design [NASA-CR-189518] N92-14892

COPOLYMERS
Controlled synthesis of polyenes by catalytic methods [DE91-018804] N92-14113

COPPER
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites [NASA-TM-105233] N92-14120
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films [DE91-018677] N92-14159
Pre-tinning and flux considerations on the reliability of solder surface [DE92-000905] N92-14189

COPPER OXIDES
Energetics and statistics of order in alloys with application to oxide superconductors [DE92-000851] N92-14148
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x) [DE92-000849] N92-14866
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x) [DE92-000898] N92-14873

CORN
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations [DE92-000402] N92-14185

CORONAL HOLES
Solar x ray astronomy rocket program [NASA-CR-183494] N92-14935

CORROSION
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils [NASA-TM-105234] N92-14179
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422

CORROSION PREVENTION
Materials behaviour in the deep sea environments N92-14195

CORROSION TESTS
Materials behaviour in the deep sea environments N92-14195
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406

COSMIC BACKGROUND EXPLORER SATELLITE
COBE experience with filter QUEST N92-14078
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080
Study of geopotential error models used in orbit determination error analysis N92-14083

COSMIC RAYS
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results [RAE-TM-SPACE-383-PT-1] N92-14099
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator [DE91-628619] N92-14942
Cosmic neutron and gamma quanta detection at balloons [DE91-638485] N92-14960
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle [DE91-625051] N92-14961
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector [DE91-625052] N92-14962

COSMOLOGY
On the fundamental principles of the relativistic theory of gravitation [DE91-636029] N92-14885
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe [DE91-634422] N92-14940

COST ANALYSIS
Avionics standardization in the USAF: 1980 to 1990 N92-14048
Solar photocatalyzed process economics N92-14452
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464

COST EFFECTIVENESS
Historical perspective on the evolution of avionics standards N92-14049
Avionics standardization in Europe N92-14050

COST ESTIMATES
Solar photocatalyzed process economics N92-14452
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2 [S-HRG-102-113-PT-2] N92-14926

COST REDUCTION
Design of the support structure, drive pedestal, and controls for a solar concentrator [DE92-000604] N92-14483

COSTS
National Aeronautics and Space Administration N92-14923

COUPLED MODES
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913

COUPLERS
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915

COUPLING CIRCUITS
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915

COVARIANCE
CDFTBL: A statistical program for generating cumulative distribution functions from data [DE92-002106] N92-14614

CRACK INITIATION
Study of mechanical behavior and internal structure of ferritic nanocrystalline material [DE92-000760] N92-14162
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture [DE91-638175] N92-14389
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS [DE91-018827] N92-14395
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426

CRACK PROPAGATION
The two-bay crack problem in fuselages built in GLARE and ARALL [LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] N92-14045
Microfracture in high temperature metal matrix laminates [NASA-TM-105189] N92-14122
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material [DE92-000926] N92-14151
Study of mechanical behavior and internal structure of ferritic nanocrystalline material [DE92-000760] N92-14162
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior [DE92-000899] N92-14164
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS [DE91-018827] N92-14395
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] N92-14397
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424

CRACKING (FRACTURING)
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410

CRACKS
The two-bay crack problem in fuselages built in GLARE and ARALL [LR-653] N92-14044
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior [DE92-000899] N92-14164
Testing a force sensor for underwater magnetic particle inspection N92-14197
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Acoustic emission [DE91-642293] N92-14796

CRASHES
The impossibility of implementing reliable communication in the face of crashes [AD-A241291] N92-14254

CREEP PROPERTIES
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors [AD-A241850] N92-14284

CRITICAL FREQUENCIES
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers [DE91-635168] N92-14556

CRITICAL TEMPERATURE
Irradiation of Bi-based superconducting ceramics with 650 MeV protons [DE91-628387] N92-14177

CROP IDENTIFICATION
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model [BCRS-90-39] N92-14442

CROSS CORRELATION
Suppressed carrier full-spectrum combining N92-14239

CROSS SECTIONS
Termolecular association and laser-assisted electron-(excited) atom collisions [AD-A241647] N92-14802

CROSSED FIELDS
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave [DE91-018424] N92-14845

CROSSTALK
Differential spot-size focus servo N92-14909

CRYOGENIC TEMPERATURE
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures [DE92-000903] N92-14150
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152

CRYOGENICS
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys [DE92-000900] N92-14149
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497

CRYSTAL DEFECTS
Non-stoichiometric defects in YBaCuO thin films [DE92-000954] N92-14867
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x) [DE92-000898] N92-14873
Defect studies in 3-5 thin film semiconductors [DE92-000052] N92-14875
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors [DE92-000893] N92-14876

CRYSTAL GROWTH
Optimal design of solidification processes N92-13944
Non-stoichiometric defects in YBaCuO thin films [DE92-000954] N92-14867
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100) [DE92-000868] N92-14872
Defect studies in 3-5 thin film semiconductors [DE92-000052] N92-14875
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors [DE92-000893] N92-14876

CRYSTAL LATTICES
Computational methods for superlattice structures: Renormalization and recursion techniques [AD-A241176] N92-14277
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors [DE91-636318] N92-14870
Anisotropy of relativistic lepton coherent scattering at axial channeling [DE91-623659] N92-14874

CRYSTAL OSCILLATORS
A receiver design for the superconducting cavity-maser oscillator N92-14238

CRYSTAL STRUCTURE
Theory of ordering transformations in metals and minerals [DE92-000855] N92-14157
A novel phase transition in alloys [DE92-000366] N92-14161
Slip, twinning and transformation in Laves phases [DE92-000764] N92-14163
Synthesis of mismatched heterojunction/substrate interfaces [AD-A241845] N92-14283
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x) [DE92-000849] N92-14866
Plotter of pole figure using data from x ray diffraction [DE91-634207] N92-14868
International Conference on Advanced Methods in X Ray and Neutron Structure Analysis of Materials [DE91-639071] N92-14871
Structures and thermodynamics of some rare earth sulfides [DE91-018554] N92-14879
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator [DE91-628619] N92-14942

CRYSTALLIZATION
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides [DE92-000815] N92-14175

CRYSTALS
First principles theoretical studies of ferroelectric lattice instabilities [AD-A241185] N92-14865
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator [DE91-628619] N92-14942

CUBIC EQUATIONS
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs [MEMO-977] N92-14616
Derivative generation in piecewise cubic C(1)-interpolation [MEMO-976] N92-14719

CUES
Synthesis of visual modules from examples: Learning hyperacuity [AD-A241159] N92-14683

CULTIVATION
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477

CULTURE TECHNIQUES
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations [DE92-000402] N92-14185

CUMULATIVE DAMAGE
Multiaxial fatigue under constant and variable amplitude loading N92-14401

CURING
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing [NASA-TM-105313] N92-14118
Material property for designing, analyzing, and fabricating space structures [NASA-CR-189516] N92-14119

CURRENT DENSITY
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle [NASA-CR-189090] N92-14436
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group [DE91-623503] N92-14710
Electrohydrodynamic emitters of ion beams [DE91-636293] N92-14828

CURRENT DISTRIBUTION
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle [NASA-CR-189090] N92-14436

CURRENT SHEETS
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956

CURVATURE
Relativistic theory of gravitation based on the constant curvature space [DE91-636027] N92-14884

CURVES (GEOMETRY)
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3 [MEMO-963] N92-14713

CUTTERS
CNC water-jet machining and cutting center [DE92-000661] N92-14187

CUTTING
CNC water-jet machining and cutting center [DE92-000661] N92-14187

CYCLES
Separatrix cycles and multiple limit cycles in a class of quadratic systems [REPT-90-84] N92-14732

CYCLIC LOADS
Microfracture in high temperature metal matrix laminates [NASA-TM-105189] N92-14122
Crack growth measurements using corner-crack- or LCF-specimens N92-14408

CYCLONES
Stratospheric dynamics N92-14537
Upper atmosphere dynamics N92-14544

CYCLOTRON RADIATION
Proposed research on advanced accelerator concepts [DE92-000824] N92-14850

CYCLOTRON RESONANCE
Proposed research on advanced accelerator concepts [DE92-000824] N92-14850

CYLINDRICAL BODIES
Method of moments analysis of scattering by chiral media [AD-A241848] N92-14257

D

DAMAGE
Structural damage identification using mathematical optimization techniques N92-13936

DAMAGE ASSESSMENT
Development of a new design method to predict impact damage tolerance of composite structures N92-14416

DAMPING
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
Proceedings of Damping 1991, volume 3 [AD-A241313] N92-14386
Second order wave forces and wave drift damping [REPT-91-34] N92-14736

DAMPING TESTS
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391

DATA ACQUISITION
The Telecommunications and Data Acquisition Report [NASA-CR-189484] N92-14237
The Rocketdyne multifunction tester. Part 1: Test method N92-14368

DATA BASE MANAGEMENT SYSTEMS
Notes on the polyinstantiation problem [RSRE-MEMO-4504] N92-14630
Dynamic action scheduling in a parallel database system [MEMO-INF-91-58] N92-14666
Object-Oriented Data Base (OODB) concepts [MEMO-INF-91-42] N92-14918
Cautious backtracking and well-founded semantics in truth maintenance systems [RUU-CS-91-26] N92-14919

DATA BASES
Hypersonic aerodynamics N92-13983
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
Neural net sensor fusion [AD-A241765] N92-14336
Database on fatigue of welded aluminium components ALUFAT N92-14399
Upper Atmosphere Data Program (UADP) N92-14553
Advanced instrumentation: Technology database enhancement, volume 4, appendix G [NASA-CR-184250] N92-14593
Next generation authoring systems: Integration of multiple methodologies and tools [REPT-90-80] N92-14601
Unified Life Cycle Engineering (ULCE) design system [AD-A241039] N92-14608
Joining distributed complex objects: Definition and performance [MEMO-INF-91-35] N92-14633
Dynamic action scheduling in a parallel database system [MEMO-INF-91-58] N92-14666
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN [AD-A241509] N92-14685
The incomplete database [ITLI-CT-91-07] N92-14722
The optimal placement of replicated items in distributed databases on tree-like networks [RUU-CS-91-23] N92-14762
Theoretical foundations for information representation and constraint specification [AD-A241842] N92-14899
Lies, damned lies, and databases [RSRE-MEMO-4503] N92-14917
Object-Oriented Data Base (OODB) concepts [MEMO-INF-91-42] N92-14918

DATA COMPRESSION
Video data compression using artificial neural network differential vector quantization N92-14214

DATA FLOW ANALYSIS
Bundle event structures: A non-interleaving semantics for LOTOS [MEMO-INF-91-60] N92-14620
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention [MEMO-INF-91-55] N92-14665

DATA INTEGRATION
Multisensor data fusion as applied to guidance and control N92-14681

DATA LINKS
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072

Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
A multi-media multi-user service for the B-ISDN [MEMO-INF-91-56] N92-14266
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system [NASA-CR-189247] N92-14700

DATA MANAGEMENT
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
Data analysis and archival N92-14551
Unified Life Cycle Engineering (ULCE) design system [AD-A241039] N92-14608
Evaluating the operations capability of Freedom's Data Management System [NASA-CR-187315] N92-14894
Standard formatted data units-control authority operations [NASA-CR-188748] N92-14896
Standard formatted data units-control authority procedures [NASA-CR-188127] N92-14897

DATA PROCESSING
Avionics standardization in Europe N92-14050
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Architecture for Survivable System Processing (ASSP) N92-14210
Neural net sensor fusion [AD-A241765] N92-14336
A concept for the revisions of structural inspection schedules N92-14431
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Summary of awards, fiscal year 1990 [NSF-90-132] N92-14602
An example machine used for developing a proof strategy for secure systems [RSRE-91022] N92-14627
Efficient hybrid rendering of volume data and polygons [REPT-91-17] N92-14650
Neural network paradigms N92-14675
Multisensor data fusion as applied to guidance and control N92-14681
An improved approach to automatic error cumulation control [MEMO-INF-91-61] N92-14720
Minimum-link c-oriented path queries [RUU-CS-91-27] N92-14747
Solid state devices N92-14772

DATA PROCESSING EQUIPMENT
Implications of interoperability and standardization for the industrial base N92-14057
A bi-directional BAUDOT/ASCII code converter [RSRE-MEMO-4479] N92-14629
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation [AD-A241697] N92-14663

DATA REDUCTION
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
High-frequency P wave spectra from explosions and earthquakes [DE91-018723] N92-14557

DATA SMOOTHING
Enhancement of surface definition and gridding in the EAGLE code [NASA-CR-189445] N92-14607

DATA STORAGE
A study of mass data storage technology for rocket engine data [NASA-CR-185272] N92-14110
Advanced computing N92-14774
Research studies on advanced optical module/head designs for optical devices [NASA-CR-189756] N92-14902
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Measurement of laser spot quality N92-14910
Micro-optic lens for data storage N92-14912
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913

DATA STRUCTURES
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal [RSRE-91014] N92-14624
Some domination problems on trees and on general graphs [RUU-CS-91-22] N92-14745
Minimum-link c-oriented path queries [RUU-CS-91-27] N92-14747
Standard formatted data units-control authority procedures [NASA-CR-188127] N92-14897

DATA SYSTEMS
Stratospheric Data Analysis System (STRATAN) N92-14539
Some practical universal noiseless coding techniques, part 3, module PSI14,K+ [NASA-CR-188718] N92-14611
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis [DE91-624093] N92-14809
Standard formatted data units-control authority operations [NASA-CR-188748] N92-14896
Object-oriented data handling system for an automated chemistry laboratory [DE92-000185] N92-14901

DATA TRANSMISSION
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
Processing complexity of two approaches to object detection and recognition N92-14677

DC 8 AIRCRAFT
DC-8 mission planning N92-14521

DC 9 AIRCRAFT
China aviation journal (selected article) [AD-A240985] N92-13990

DEBRIS
Filter debris analysis: A concrete approach to wear diagnosis [DREP-TM-88-20] N92-14345

DECISION MAKING
Neural net sensor fusion [AD-A241765] N92-14336
Advance neural network architectures for guidance and control N92-14682
A model of the self-explanation effect [AD-A241200] N92-14684
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN [AD-A241509] N92-14685
New Ways: Tiltrotor aircraft and magnetically levitated vehicles [OTA-SET-507] N92-14933

DECISION THEORY
A new device for the synthesis problem of optimal control of admission to an M/M/c queue [CWI-BS-R9101] N92-14698
Scale sensitivity and rank preservation in a multiplicative variant of the analytic hierarchy process [REPT-91-20] N92-14758

DECODERS
A B-ISDN-compatible modem/codec N92-14229
Flexible High Speed Codec (FHSC) N92-14230
Determinate-state convolutional codes N92-14242
Some partial-unit-memory convolutional codes N92-14243

DECODING
Multi-stage decoding of multi-level modulation codes N92-14233
Determinate-state convolutional codes N92-14242

DECOMPOSITION
Formal and heuristic system decomposition methods in multidisciplinary synthesis [NASA-CR-4413] N92-14041
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
Empirical population synthesis: New directions N92-14938

DECOUPLING
Minimality of dynamic input-output decoupling for nonlinear systems [MEMO-960] N92-14688
Further results in the triangular decoupling problem for nonlinear systems [MEMO-941] N92-14724
Equivalence of nonlinear systems to input-output prime forms [MEMO-975] N92-14752

DEEP SPACE
Some partial-unit-memory convolutional codes N92-14243

DEEP SPACE NETWORK
The Telecommunications and Data Acquisition Report [NASA-CR-189484] N92-14237
A minimalist approach to receiver architecture N92-14241
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
Mark 4A antenna control system data handling architecture study N92-14247
Expected antenna utilization and overload N92-14248

DEEP WATER
Pressure chamber for simulation of deep sea conditions N92-14194
Materials behaviour in the deep sea environments N92-14195

DEFECTS
High energy heavy ion irradiation effect on defect structure of metals [DE91-638281] N92-14146
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
Defect studies in 3-5 thin film semiconductors [DE92-000052] N92-14875

DEFENSE PROGRAM
The Conflicting Forces Driving Future Avionics Acquisition [AGARD-LS-176] N92-14046
Avionics standardization in the USAF: 1980 to 1990 N92-14048

DEFINITION
Fourier transformation in an algebra of generalized functions [MEMO-954] N92-14730

DEFLECTION
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152

DEFORMATION
The deformation modes of continuous fibre reinforcements in thermoplastic composites during thermoforming: A preliminary hierarchy and geometrical description [LR-654] N92-14123
Slip, twinning and transformation in Laves phases [DE92-000764] N92-14163
Flexural deformation of the continental lithosphere [NASA-CR-189474] N92-14555

DEGRADATION
Qualification testing of a diode-laser transmitter for free-space coherent communications [AD-A241728] N92-14335
Effect of light intensity on photocatalytic reaction N92-14449

DELAMINATING
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] N92-14382
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
Delamination imaging in CFRP laminates N92-14418
Delamination onset in polymeric composite laminates under thermal and mechanical loads [NASA-CR-189548] N92-14432

DEMODULATION
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
DEMODULATORS
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205
A reconfigurable multicarrier demodulator architecture N92-14213
Laboratory measurements of on-board subsystems N92-14216
On-board demux/demod N92-14221
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
On-board processing for telecommunications satellites N92-14227
Multi-rate demodulator architecture N92-14232
DEMULTIPLEXING
Fault-tolerant multichannel demultiplexer subsystems N92-14220
On-board demux/demod N92-14221
DENSITY DISTRIBUTION
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
DENSITY MEASUREMENT
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
Rocket temperature soundings N92-14523
DEPOSITION
Sequential deposition etch techniques for the selective deposition of tungsten
[DE92-000953] N92-14165
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
DEPOSITS
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
DEPTH
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
DESCRIPTIVE GEOMETRY
A CSG scanline algorithm for quadrics
[REPT-90-90] N92-14645
DESIGN ANALYSIS
Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3)
[NASA-CR-188125] N92-13928
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934
Finite element structural redesign by large admissible perturbations N92-13935
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
The turbomachine blading design using S2-S1 approach N92-13940
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
Inverse problems in the design, modeling and testing of engineering systems N92-13966
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
An inverse method with regularity condition for transonic airfoil design N92-13969
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Design of transonic compressor cascades using hodograph method N92-13973
A DME transponder system approach for convertibility, monitoring, and diagnostics N92-14022
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades
[NASA-CR-189018] N92-14038
Formal and heuristic system decomposition methods in multidisciplinary synthesis
[NASA-CR-4413] N92-14041
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056
Proceedings of Damping 1991, volume 3
[AD-A241313] N92-14386
Development of a new design method to predict impact damage tolerance of composite structures N92-14416
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
Theoretical models for duct acoustic propagation and radiation N92-14782
Design and performance of duct acoustic treatment N92-14783
DESORPTION
The puzzles of surface science and recent attempts to explain them
[DE92-000928] N92-14136
High-temperature photochemistry induced by concentrated solar radiation N92-14457
DESTRUCTION
Waste treatment N92-14456
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Thermal emission spectroscopy of the middle atmosphere N92-14502
DETECTION
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Processing complexity of two approaches to object detection and recognition N92-14677
DETECTORS
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
DETONATION
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
DIAMOND FILMS
Solid state devices N92-14772
DIELECTRIC PROPERTIES
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
Photophysics and photochemistry of porphyrin systems N92-14470
DIELECTRICS
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
DIELS-ALDER REACTIONS
Study of improved methods for predicting chemical equilibria
[DE91-018803] N92-14129
DIESEL ENGINES
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
DIFFERENCE EQUATIONS
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
DIFFERENTIAL EQUATIONS
Stoermer-Cowell- and related methods for the numerical solution of second order periodic initial value problems for ODE's. 1: Survey of methods
[MEMO-966] N92-14714
On defining classes of quadratic systems in the plane
[REPT-91-32] N92-14735
DIFFRACTION
Inverse problems in diffraction N92-13971
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913
DIFFRACTION PATTERNS
Practical design considerations and performance characteristics of high numerical aperture holographic lenses N92-14914
DIFFUSERS
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
DIFFUSION
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063
DIFFUSION COEFFICIENT
Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: A molecular dynamics study
[DE91-623616] N92-14131
DIGITAL DATA
Historical perspective on the evolution of avionics standards N92-14049
Evaluating the operations capability of Freedom's Data Management System
[NASA-CR-187315] N92-14894
DIGITAL FILTERS
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
DIGITAL NAVIGATION
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory
[AD-A241692] N92-14658
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 3, task 1: Digital emulation technology laboratory
[AD-A241693] N92-14659
DIGITAL SIMULATION
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory
[AD-A241692] N92-14658
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 3, task 1: Digital emulation technology laboratory
[AD-A241693] N92-14659
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
DIGITAL SYSTEMS
Historical perspective on the evolution of avionics standards N92-14049
On-board processing architectures for satellite B-ISDN services N92-14203
A reconfigurable multicarrier demodulator architecture N92-14213
Programmable digital modem N92-14231
DIODES
Laser beam modeling in optical storage systems N92-14911
DIOPHANTINE EQUATION
A hyperelliptic diophantine equation related to imaginary quadratic number fields with class number 2
[MEMO-978] N92-14617
DIPOLE ANTENNAS
Radiation from a dipole antenna into an inhomogeneous, comprehensible, and nonlinear space-plasma
[DLR-FB-91-05] N92-14269
DIRAC EQUATION
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886
DIRECT CURRENT
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
DIRICHLET PROBLEM
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
Positive solutions of semilinear elliptic systems
[REPT-91-16] N92-14734
DISCONNECT DEVICES
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375
DISCRETE FUNCTIONS
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
DISPLACEMENT
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
DISPLAY DEVICES
Automated baggage threat detection N92-14032
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034
DISSOCIATION
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842

DISTANCE MEASURING EQUIPMENT
DME growth elements and their use with MLS N92-14018
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Testing MLS DME/P transponders and interrogators N92-14020
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
A DME transponder system approach for convertibility, monitoring, and diagnostics N92-14022
DISTORTION
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
DISTRIBUTED PARAMETER SYSTEMS
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967
Finite-dimensional robust controller designs for distributed parameter systems: A survey
[W-9104] N92-14699
DISTRIBUTED PROCESSING
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271
An engineering approach to ODP systems design
[MEMO-INF-91-49] N92-14600
Joining distributed complex objects: Definition and performance
[MEMO-INF-91-35] N92-14633
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635
An exercise in protocol synthesis
[MEMO-INF-91-46] N92-14636
Addressing performance requirements in the FDT based design of distributed systems
[MEMO-INF-91-48] N92-14638
Algorithms for the correct implementation of scheduling policies in distributed systems
[REPT-90-91] N92-14646
Integrating security in a group oriented distributed system
[NASA-CR-189498] N92-14656
Network orientation
[RUU-CS-91-8] N92-14667
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188836] N92-14694
Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762
DISTRIBUTION (PROPERTY)
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
DISTRIBUTION FUNCTIONS
CDFTBL: A statistical program for generating cumulative distribution functions from data
[DE92-002106] N92-14614
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761
DIURNAL VARIATIONS
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
DOCUMENTATION
The 1990 Johnson Space Center bibliography of scientific and technical papers
[NASA-TM-104746] N92-14965
DOCUMENTS
Antarctic news clips, 1991
[NSF-91-79] N92-14561
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
DOMAIN WALL
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907
DOMAINS
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
DOPED CRYSTALS
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139
DOPPLER EFFECT
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342
DOPPLER RADAR
Cosmic background explorer (COBE) navigation with TDRSS one-way return-link Doppler in the post-helium-venting phase N92-14071
Ranging standard. Volume 1: Direct ground to spacecraft ranging
[ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
DOSIMETERS
Determination of energy distribution for photon and neutron microdosimetry
[DE91-640663] N92-14819
DOWN-CONVERTERS
A minimalist approach to receiver architecture N92-14241
DOWNLINKING
Satellite B-ISDN traffic analysis N92-14208
On-board demux/demod N92-14221
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
COMSAT Laboratories' on-board baseband switch development N92-14225
DRAG REDUCTION
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999
DROP SIZE
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315
DUCTED FLOW
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Adjoint operator approach to shape design for internal incompressible flows N92-13957
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
DUCTILITY
Slip, twinning and transformation in Laves phases
[DE92-000764] N92-14163
DUCTS
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
DUNALIELLA
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477
DURABILITY
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056
DUST
Shock waves, implosions and dusty gases N92-13986
DYE LASERS
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
DYNAMIC CHARACTERISTICS
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
Motion dynamics of submersibles N92-14191
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
Fluid compressibility effects on the dynamic response of hydrostatic journal bearings N92-14372
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373
Method and apparatus for synchronization of dynamical physical systems
[AD-D015020] N92-14376
DYNAMIC CONTROL
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390
Minimality of dynamic input-output decoupling for nonlinear systems
[MEMO-960] N92-14688
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693
DYNAMIC LOADS
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
DYNAMIC MODELS
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
DYNAMIC PRESSURE
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
DYNAMIC PROGRAMMING
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
Dynamic action scheduling in a parallel database system
[MEMO-INF-91-58] N92-14666
A new device for the synthesis problem of optimal control of admission to an M/M/c queue
[CWI-BS-R9101] N92-14698
DYNAMIC RANGE
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
DYNAMIC RESPONSE
Finite element structural redesign by large admissible perturbations N92-13935
Dynamics of risers --- associated with offshore platforms N92-14200
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
Fluid compressibility effects on the dynamic response of hydrostatic journal bearings N92-14372
Response level of precipitation sensors
[ETN-92-90311] N92-14573
DYNAMIC STABILITY
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865
DYNAMIC STRUCTURAL ANALYSIS
Structural damage identification using mathematical optimization techniques N92-13936
Spacecraft dynamics and control N92-13988
Dynamics of risers --- associated with offshore platforms N92-14200
Static and dynamic strength of joints in ARALL-laminates N92-14423
DYNAMICAL SYSTEMS
Method and apparatus for synchronization of dynamical physical systems
[AD-D015020] N92-14376
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems
[AD-A241160] N92-14384

Advance neural network architectures for guidance and control N92-14682
On the symbolic calculation of periodic orbits for the logistic map
[MEMO-965] N92-14715

E

EARTH (PLANET)
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
EARTH ATMOSPHERE
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943
EARTH ENVIRONMENT
Need for expanded environmental measurement capabilities in geosynchronous Earth orbit
[NASA-CR-183487] N92-14490
EARTH IONOSPHERE
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers
[DE91-635168] N92-14556
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
EARTH LIMB
Analysis of observations of the middle atmosphere from satellites N92-14545
EARTH MAGNETOSPHERE
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
EARTH OBSERVATIONS (FROM SPACE)
Need for expanded environmental measurement capabilities in geosynchronous Earth orbit
[NASA-CR-183487] N92-14490
EARTH OBSERVING SYSTEM (EOS)
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Mission and sampling analyses for atmospheric satellite experiments N92-14554
EARTH ORBITAL ENVIRONMENTS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces
[NASA-TM-105363] N92-14114
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
EARTH SCIENCES
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-91-006] N92-14439
EARTH-MARS TRAJECTORIES
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249
EARTHQUAKES
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
ECCENTRICITY
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373
ECONOMIC ANALYSIS
Capital investment in semiconductors: The lifeblood of the US semiconductor industry
[PB91-165902] N92-14272
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464
ECONOMIC FACTORS
Solar technology applications in chemical waste management N92-14459
ECONOMICS
Solar photocatalyzed process economics N92-14452
Waste treatment N92-14456
ECOSYSTEMS
Initial assessments of life support technology evolution and advanced sensor requirements, volume 2, appendix A
[NASA-CR-184248] N92-14591
Advanced instrumentation: Technology database enhancement, volume 4, appendix G
[NASA-CR-184250] N92-14593
Advanced life support study
[NASA-CR-184247] N92-14595
EDDY VISCOSITY
Modelling of turbulent heat transport: A state-of-the-art
[VKI-TM-47] N92-14329
EDGE DETECTION
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
EDUCATION
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601
Case study of a national educational software development program: The Netherlands
[REPT-91-15] N92-14648
Education stimulation project COO for A30-CT
[REPT-90-87] N92-14893
Annual Research Summary, 1 July 1990 to 30 June 1991 N92-14964
EFFERENT NERVOUS SYSTEMS
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
EFFLUENTS
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
EIGENVECTORS
Scaling properties of band random matrices
[DE91-635977] N92-14705
EINSTEIN EQUATIONS
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558
EL NINO
Physical processes responsible for ENSO events
[DE91-635166] N92-14569
ELASTIC PLATES
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
ELASTIC PROPERTIES
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
ELASTIC SCATTERING
Potential reconstruction from R-matrix resonance positions and reduced widths
[DE91-628029] N92-14708
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834
ELECTRIC BATTERIES
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
The environmentally safe battery
[DE92-001715] N92-14293
ELECTRIC CHARGE
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749
Classical theory of a structural point object in the 2nd order approximation
[DE91-628031] N92-14818
ELECTRIC CONDUCTORS
Transfer impedance of coaxial cables
[DE91-018411] N92-14273
ELECTRIC CONTACTS
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375
ELECTRIC CURRENT
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
ELECTRIC DISCHARGES
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
ELECTRIC FIELDS
Molecular design concept for x ray laser research
[DE92-000972] N92-14343
Field calculation algorithm for general beam distributions
[DE92-002017] N92-14836
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14856
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
1/N-expansion in quantum mechanics, part 2
[DE91-635987] N92-14883
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt
[DE91-623793] N92-14952
ELECTRIC MOMENTS
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946
ELECTRIC MOTORS
Converting a commercial electric direct-drive robot to operate from joint torque commands
[DE92-000611] N92-14687
ELECTRIC POTENTIAL
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
ELECTRIC POWER SUPPLIES
Energy source possibilities in underwater technics N92-14193
Electrical power supply for short term power interruptions
[AD-D014998] N92-14261
ELECTRICAL ENGINEERING
Annual Research Summary, 1 July 1990 to 30 June 1991 N92-14964
ELECTRICAL IMPEDANCE
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
Transfer impedance of coaxial cables
[DE91-018411] N92-14273
ELECTRICAL INSULATION
Transfer impedance of coaxial cables
[DE91-018411] N92-14273
ELECTRICAL MEASUREMENT
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
ELECTRICAL RESISTANCE
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284
ELECTRICAL RESISTIVITY
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Sequential deposition etch techniques for the selective deposition of tungsten
[DE92-000953] N92-14165
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
Characterization of magneto-optical media N92-14903
ELECTRICITY
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
ELECTROCHEMICAL OXIDATION
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282

ELECTROCHEMISTRY
Electrochemical noise measurement technique for the determination of aluminum alloy pit initiation rates
[AD-D015050] N92-14144
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
ELECTRODEPOSITION
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
ELECTRODES
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
ELECTRODYNAMICS
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
On the electrodynamics of spinning particles
[NIKHEF-H/90-22] N92-14822
ELECTROHYDRODYNAMICS
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
ELECTROLYTES
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
ELECTROMAGNETIC ABSORPTION
Enhancing optical absorption in InP and GaAs utilizing profile etching
[NASA-TM-105325] N92-14111
ELECTROMAGNETIC FIELDS
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Method of moments analysis of scattering by chiral media
[AD-A241848] N92-14257
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group
[DE91-623503] N92-14710
ELECTROMAGNETIC INTERACTIONS
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813
ELECTROMAGNETIC INTERFERENCE
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
ELECTROMAGNETIC NOISE
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
Two-dimensional adaptive enhancement and detection of linear features in noisy images
[DE92-000982] N92-14613
ELECTROMAGNETIC PROPERTIES
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
ELECTROMAGNETIC RADIATION
A coupled time and frequency approach for nonlinear wave radiation N92-14301
Photonics N92-14773
ELECTROMAGNETIC SCATTERING
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267
ELECTROMECHANICS
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
ELECTROMIGRATION
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
ELECTRON ACCELERATION
A thermal/nonthermal approach to solar flares
[NASA-TM-4323] N92-14956
ELECTRON BEAMS
Ionizing radiation survey
[AD-A240966] N92-14253
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
ELECTRON BOMBARDMENT
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
ELECTRON DENSITY PROFILES
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers
[DE91-635168] N92-14556
ELECTRON ENERGY
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
ELECTRON MOBILITY
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
ELECTRON PLASMA
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
ELECTRON SCATTERING
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802
ELECTRON STATES
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
ELECTRON TRANSFER
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
Photocatalyzed removal of multiple contaminants from water N92-14453
Photophysics and photochemistry of porphyrin systems N92-14470
ELECTRON TRANSITIONS
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
ELECTRONIC COUNTERMEASURES
Adaptive optical processor
[AD-A241535] N92-14837
ELECTRONIC EQUIPMENT
Electronic systems in transportation
[TP-9983] N92-14009
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
ELECTRONIC EQUIPMENT TESTS
Image-supported navigation for testing instrument landing systems N92-14012
Comprehensive MLS testing for category 1, 2, and 3 operation N92-14013
MLS testing using built-in test N92-14024
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
ELECTRONIC FILTERS
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
ELECTRONIC MODULES
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
ELECTRONIC WARFARE
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067
ELECTRONS
Applications of neural networks in high energy physics
[DE90-013325] N92-14825
ELECTROSTATICS
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
ELLIPTIC FUNCTIONS
Positive solutions of semilinear elliptic systems
[REPT-91-16] N92-14734
ELLIPTICITY
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
ELONGATION
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
EMBEDDED COMPUTER SYSTEMS
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
EMBRITTLEMENT
Grain boundary fracture and alloy design of intermetallics
[DE91-018253] N92-14145
EMISSION
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
EMISSION SPECTRA
Thermal emission spectroscopy of the middle atmosphere N92-14502
EMITTANCE
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
EMITTERS
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
END-TO-END DATA SYSTEMS
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205
ENDOTHERMIC REACTIONS
Chemical reactions driven by concentrated solar energy N92-14475
ENERGY BANDS
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
ENERGY BUDGETS
The stratospheric residual circulation as deduced from satellite data N92-14498
ENERGY CONSERVATION
Heat pumps for industry
[DE91-015030] N92-14318
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
ENERGY CONSUMPTION
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
ENERGY DISSIPATION
Determination of energy distribution for photon and neutron microdosimetry
[DE91-640663] N92-14819
ENERGY DISTRIBUTION
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939
ENERGY GAPS (SOLID STATE)
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869

ENERGY LEVELS
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138
Potential reconstruction from R-matrix resonance positions and reduced widths
[DE91-628029] N92-14708
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
ENERGY SPECTRA
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
Phase-space constraints on inclusive energy spectra of heavy ion fragmentation at intermediate energies
[DE91-641867] N92-14835
Rotating relativistic neutron stars
[DE92-000806] N92-14941
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector
[DE91-625052] N92-14962
ENERGY STORAGE
Energy source possibilities in underwater technics N92-14193
Thermochemical energy storage for a lunar base
[NASA-TM-105333] N92-14485
ENERGY TECHNOLOGY
Energy source possibilities in underwater technics N92-14193
Potential Applications of Concentrated Solar Energy
[NAP-S-416] N92-14445
Solar photocatalyzed process economics N92-14452
Immobilized catalysts in solar concentrators N92-14454
Photocatalysis with large-scale trough collectors N92-14455
Waste treatment N92-14456
Solar pumped lasers and their applications N92-14468
Fuel processing and thermochemical/photochemical cycles N92-14472
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862
ENERGY TRANSFER
Molecular design concept for x ray laser research
[DE92-000972] N92-14343
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764
ENGINE AIRFRAME INTEGRATION
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
ENGINE CONTROL
A study of mass data storage technology for rocket engine data
[NASA-CR-185272] N92-14110
ENGINE DESIGN
International aviation (selected article)
[AD-A240987] N92-13992
Theoretical models for duct acoustic propagation and radiation N92-14782
ENGINE INLETS
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
Numerical investigations in three-dimensional internal flows
[NASA-CR-189467] N92-14313
ENGINE MONITORING INSTRUMENTS
A study of mass data storage technology for rocket engine data
[NASA-CR-185272] N92-14110
ENGINE NOISE
Design and performance of duct acoustic treatment N92-14783
Quiet aircraft design and operational characteristics N92-14787
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797
ENGINE PARTS
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
ENGINE TESTS
High-power hydrogen arcjet performance
[NASA-TM-105143] N92-14109
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
ENVIRONMENT EFFECTS
The environmentally safe battery
[DE92-001715] N92-14293
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422
ENVIRONMENT MANAGEMENT
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791
ENVIRONMENT PROTECTION
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924
ENVIRONMENT SIMULATION
Pressure chamber for simulation of deep sea conditions N92-14194
ENVIRONMENT SIMULATORS
A chaotic system for the generation of extreme mechanical environments
[DE91-018358] N92-14388
ENVIRONMENTAL CONTROL
Advanced instrumentation: Technology database enhancement, volume 4, appendix G
[NASA-CR-184250] N92-14593
Clean room survey and assessment, volume 5, appendix H
[NASA-CR-184251] N92-14594
Advanced life support study
[NASA-CR-184247] N92-14595
ENVIRONMENTAL MONITORING
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
Need for expanded environmental measurement capabilities in geosynchronous Earth orbit
[NASA-CR-183487] N92-14490
ENVIRONMENTAL QUALITY
Object-oriented data handling system for an automated chemistry laboratory
[DE92-000185] N92-14901
ENVIRONMENTAL SURVEYS
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791
Modeling nonlinear acoustical blast waves outdoors: A research summary
[AD-A241030] N92-14792
ENVIRONMENTAL TESTS
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335
Environmental fatigue tests with composite materials N92-14413
Comparison between hot/wet test and RT/dry test on the Seastar horizontal stabilizer and fin N92-14414
EPHEMERIDES
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
EQUATIONS OF MOTION
Stoermer-Cowell- and related methods for the numerical solution of second order periodic initial value problems for ODE's. 1: Survey of methods
[MEMO-966] N92-14714
Classical theory of a structural point object in the 2nd order approximation
[DE91-628031] N92-14818
EQUATIONS OF STATE
Rational approximations to fluid properties
[DE90-012531] N92-14297
EQUILIBRIUM FLOW
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] N92-14325
EQUIPMENT SPECIFICATIONS
Streak camera receiver definition study
[NASA-CR-189251] N92-14330
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953
EQUIVALENCE
Weak equivalence for constraint sets
[ITLI-CT-91-05] N92-14621
Secure refinement
[RSRE-91019] N92-14626
Equivalence of nonlinear systems to input-output prime forms
[MEMO-975] N92-14752
EQUIVALENT CIRCUITS
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
ERGODIC PROCESS
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
Random additive functionals with rapid Markov switchings
[CWI-AM-R9104] N92-14760
Zero drift random walk on N by N with reflection, ergodicity conditions
[CWI-BS-R9114] N92-14770
EROSION
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560
ERROR ANALYSIS
The effect of error tolerances on MLS array antenna N92-14014
MLS system error model identification and synthesis N92-14015
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth+Moon elliptic restricted three-body problem
[AD-A241690] N92-14069
Study of geopotential error models used in orbit determination error analysis N92-14083
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
An improved approach to automatic error cumulation control
[MEMO-INF-91-61] N92-14720
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761
Justification for reporting negative value counting results as an alternative to minimum detectable activity
[DE91-018165] N92-14803
ERROR CORRECTING CODES
Some partial-unit-memory convolutional codes N92-14243
ERRORS
Guidance angle measurement of an MLS antenna N92-14011
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
Study of geopotential error models used in orbit determination error analysis N92-14083
ESTIMATES
Colored noise effects on batch attitude accuracy estimates N92-14093
ESTIMATORS
A comparison of some quick algorithms for robust regression
[REPT-90-92] N92-14647
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
ETCHANTS
Enhancing optical absorption in InP and GaAs utilizing profile etching
[NASA-TM-105325] N92-14111
ETCHING
Enhancing optical absorption in InP and GaAs utilizing profile etching
[NASA-TM-105325] N92-14111
Sequential deposition etch techniques for the selective deposition of tungsten
[DE92-000953] N92-14165

Preoxidation cleaning optimization for crystalline silicon
[DE92-000981] N92-14178

ETHYL ALCOHOL
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185

ETHYLENE COMPOUNDS
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282

EUCLIDEAN GEOMETRY
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713

EULER BUCKLING
Finite element structural redesign by large admissible perturbations N92-13935

EULER EQUATIONS OF MOTION
Blade design and analysis using a modified Euler solver N92-13952
LEWICE/E: An Euler based ice accretion code
[NASA-TM-105389] N92-14001
A boundary integral approach in primitive variables for free surface flows N92-14304

EUROPE
Avionics standardization in Europe N92-14050

EUROPIUM
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138

EUROPIUM COMPOUNDS
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804

EVENTS
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635

EXCIMER LASERS
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Pulsed laser processing of solar cells N92-14462

EXCITATION
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842

EXHAUST NOZZLES
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934
Jet noise suppression N92-14784

EXPERIMENT DESIGN
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967
ITER diagnostics
[DE91-626549] N92-14851
ITER conceptual design activities
[DE91-626576] N92-14853

EXPERT SYSTEMS
Flight simulation N92-13982
Automated problem resolution prototype in automated en route air traffic control N92-14028
Formal and heuristic system decomposition methods in multidisciplinary synthesis
[NASA-CR-4413] N92-14041
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline
[NASA-CR-189510] N92-14134
Architecture for Survivable System Processing (ASSP) N92-14210
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
FIDEX: An expert system for satellite diagnostics N92-14218
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649
A neural network architecture for implementation of expert systems for real time monitoring
[NASA-CR-188988] N92-14669
Automated implementation of rule-based expert systems with neural networks for time-critical applications N92-14670
A neural network design methodology: Considerations and issues for design and project management N92-14676
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700

EXPLORER SATELLITES
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700

EXPLOSIONS
COBE ground segment attitude determination N92-14079

EXPLOSIVES
Deformation, fracture and explosive properties of reactive materials
[AD-A241123] N92-14181
Insensitive high density explosive
[AD-D015026] N92-14183

EXPONENTIAL FUNCTIONS
Census techniques on relativized space classes
[ITLI-CT-91-06] N92-14721

EXTENSOMETERS
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433

EXTERNAL SURFACE CURRENTS
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267

EXTRAGALACTIC RADIO SOURCES
Radio frequency investigations of the interstellar medium N92-14936

EXTRAPOLATION
Computational fluid dynamics N92-13979

EXTREMELY HIGH FREQUENCIES
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953

EXTREMUM VALUES
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761

F

F-15 AIRCRAFT
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067

F-16 AIRCRAFT
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588

FABRICATION
Hypersonic aerodynamics N92-13983
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
Pulsed laser processing of solar cells N92-14462

FABRICS
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174

FACE CENTERED CUBIC LATTICES
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157

FAILURE
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367

FAILURE ANALYSIS
Structural mechanics and materials science N92-13989
Optimization of the calculation margins of landing gears under extreme loads. Rupture static tests. Part 1: Program and test implantation
[CEAT-S8-6551-PARTIEL-1-PT-1] N92-14043
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634

FAR FIELDS
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788

FAR INFRARED RADIATION
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530

FAST FOURIER TRANSFORMATIONS
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250

FAST NEUTRONS
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis
[DE91-624093] N92-14809

FATIGUE (MATERIALS)
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
Study of mechanical behavior and internal structure of ferritic nanocrystalline material
[DE92-000760] N92-14162
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior
[DE92-000899] N92-14164
Fatigue of repaired composite structures N92-14411
Environmental fatigue tests with composite materials N92-14413
Comparison between hot/wet test and RT/dry test on the Seastar horizontal stabilizer and fin N92-14414
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420

FATIGUE LIFE
Structural mechanics and materials science N92-13989
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045
The effects of multiple repairs on Inconel 718 weld mechanical properties
[NASA-TM-103559] N92-14380
Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] N92-14397
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Low cycle fatigue of cast nickel base turbine rotors N92-14405
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
Fatigue behaviour of circumferential joints N92-14421
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429
The effect of overloads on life-time N92-14430

FATIGUE TESTS
Specimens for fatigue and fracture evaluation of metals: FRAG recommendations (first issue)
[RAE-TR-91025] N92-14166
Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] N92-14397
Assessment of the fatigue behaviour of the microalloyed steels 27MnVS6 and 38MnVS5 N92-14400
Multiaxial fatigue under constant and variable amplitude loading N92-14401
Low cycle fatigue of cast nickel base turbine rotors N92-14405
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Fatigue of repaired composite structures N92-14411
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
Environmental fatigue tests with composite materials N92-14413
Comparison between hot/wet test and RT/dry test on the Seastar horizontal stabilizer and fin N92-14414
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
Fatigue behaviour of circumferential joints N92-14421
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
Methodology for assessment of skin repairs on Airbus aircraft N92-14428
The effect of overloads on life-time N92-14430

FAULT TOLERANCE
FIDEX: An expert system for satellite diagnostics N92-14218
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
Fault-tolerant multichannel demultiplexer subsystems N92-14220
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Neural networks for target recognition N92-14678
Approximate performability analysis using generalized stochastic Petri nets
[MEMO-INF-91-40] N92-14755

FEASIBILITY ANALYSIS
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649

FEDERAL BUDGETS
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
National Aeronautics and Space Administration N92-14921
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
National Aeronautics and Space Administration N92-14923
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924
National Aeronautics and Space Administration N92-14925
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2
[S-HRG-102-113-PT-2] N92-14926
National Aeronautics and Space Administration N92-14927
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929

FEEDBACK CONTROL
Bandwidth-limited robust nonlinear spacecraft control N92-14100
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances
[MEMO-973] N92-14379
Minimality of dynamic input-output decoupling for nonlinear systems
[MEMO-960] N92-14688
Finite-dimensional robust controller designs for distributed parameter systems: A survey
[W-9104] N92-14699
Further results in the triangular decoupling problem for nonlinear systems
[MEMO-941] N92-14724
Equivalence of nonlinear systems to input-output prime forms
[MEMO-975] N92-14752
Adaptive optical processor
[AD-A241535] N92-14837

FERMENTATION
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185

FERRITIC STAINLESS STEELS
Improvement of fatigue behaviour of sintered steels by surface rolling N92-14404

FERROELECTRICITY
First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865

FERROMAGNETIC MATERIALS
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381

FEYNMAN DIAGRAMS
Basic procedure of measuring the relativistic length and its modifications
[DE91-628072] N92-14260
Program complex for problems of atomic physics, part 3
[DE91-636263] N92-14812

FIBER COMPOSITES
Structural mechanics and materials science N92-13989
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites
[NASA-TM-105233] N92-14120
The deformation modes of continuous fibre reinforcements in thermoplastic composites during thermoforming: A preliminary hierarchy and geometrical description
[LR-654] N92-14123
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433

FIBER OPTICS
Fiber optic smart structures N92-13980
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
On-board demux/demod N92-14221
Photonics N92-14773
High pressure fiber optic connector plug
[AD-D015033] N92-14839

FIBERS
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059

FIELD COILS
Measurements at the coil B604
[DIGEL-1991-4] N92-14296

FIELD EFFECT TRANSISTORS
Synthesis of mismatched heterojunction/substrate interfaces
[AD-A241845] N92-14283
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295

FIELD THEORY (PHYSICS)
Recent developments in the Virasoro master equation
[DE92-000811] N92-14703
Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group
[DE91-623503] N92-14710
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749
Quarks in the instanton vacuum. 1: Quark propagator
[DE91-637129] N92-14806
Discrete anti-gravity
[DE91-011756] N92-14878
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886
Phase space structure in gauge theories
[DE91-623483] N92-14890

FIGHTER AIRCRAFT
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Implications of interoperability and standardization for the industrial base N92-14057
Avionics technology beyond 2000 N92-14058

FIGURE OF MERIT
Measurement of laser spot quality N92-14910

FILE MAINTENANCE (COMPUTERS)
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919

FILLERS
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184

FILLETS
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063

FILLING
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184

FILTRATION
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169

FINE STRUCTURE
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701

FINITE DIFFERENCE THEORY
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390

FINITE ELEMENT METHOD
Finite element structural redesign by large admissible perturbations N92-13935
Optimal design of solidification processes N92-13944
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393

Stress intensity factors for structural details of welded components N92-14407
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle
[NASA-CR-189090] N92-14436
Triangle sets in PHIGS PLUS: A valuable link with finite element modeling
[CWI-CS-R9110] N92-14655

FINITE VOLUME METHOD
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] N92-14326
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] N92-14328

FISSION
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis
[DE91-624093] N92-14809

FIXED POINT ARITHMETIC
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250

FIXED POINTS (MATHEMATICS)
Constructive fixpoint semantics for truth maintenance systems
[REPT-90-85] N92-14641

FLAME SPRAYING
Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182

FLAMES
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133

FLEXIBLE BODIES
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances
[MEMO-973] N92-14379
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390
Active vibration damping of flexible structure
[ESA-TT-1217] N92-14438

FLEXIBLE SPACECRAFT
Spacecraft dynamics and control N92-13988

FLEXING
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555

FLIGHT CONTROL
DME growth elements and their use with MLS N92-14018
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065

FLIGHT CREWS
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597

FLIGHT OPERATIONS
Navigation of the TSS-1 mission N92-14076

FLIGHT SIMULATION
Flight research N92-13981
Flight simulation N92-13982
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067

FLIGHT SIMULATORS
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588

FLIGHT TESTS
Flight research N92-13981
Comprehensive MLS testing for category 1, 2, and 3 operation N92-14013
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764

FLIGHT TRAINING
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590

FLOATING
A numerical research of nonlinear body-wave interactions N92-14302
Effect of viscous damping on the response of floating bodies N92-14303

FLOATING POINT ARITHMETIC
An improved approach to automatic error cumulation control
[MEMO-INF-91-61] N92-14720

FLOW COEFFICIENTS
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356

FLOW DISTRIBUTION
The turbomachine blading design using S2-S1 approach N92-13940
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
Research on inverse methods and optimization in Italy N92-13956
Adjoint operator approach to shape design for internal incompressible flows N92-13957
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
Airfoil optimization with efficient gradient calculations N92-13960
Design optimization of transonic airfoils N92-13961
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063
Eighteenth Symposium on Naval Hydrodynamics
[LC-91-62359] N92-14300
A coupled time and frequency approach for nonlinear wave radiation N92-14301
A numerical research of nonlinear body-wave interactions N92-14302
Effect of viscous damping on the response of floating bodies N92-14303
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788
Flow boiling with enhancement devices for cold plate coolant channel design
[NASA-CR-189518] N92-14892

FLOW EQUATIONS
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974
On a doubly degenerate equation arising in fresh-salt water flow with pumping
[REPT-91-30] N92-14324

FLOW MEASUREMENT
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
Turbulence measurements in axisymmetric jets of air and helium N92-14299
Turbulence measurements in a submerged jet near a free surface N92-14305

FLOW STABILITY
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354

FLOW VELOCITY
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
High-power hydrogen arcjet performance
[NASA-TM-105143] N92-14109
A numerical research of nonlinear body-wave interactions N92-14302
Turbulence measurements in a submerged jet near a free surface N92-14305

FLOW VISUALIZATION
Turbulence measurements in a submerged jet near a free surface N92-14305

FLUID DYNAMICS
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
An inverse method with regularity condition for transonic airfoil design N92-13969
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994

FLUID FILMS
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322

FLUID FILTERS
Filter debris analysis: A concrete approach to wear diagnosis
[DREP-TM-88-20] N92-14345

FLUID FLOW
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327

FLUID MANAGEMENT
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320

FLUID MECHANICS
Rational approximations to fluid properties
[DE90-012531] N92-14297

FLUIDS
Rational approximations to fluid properties
[DE90-012531] N92-14297

FLUORESCENCE
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804

FLUXES
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189

FOCUSING
To acceleration and focusing theory in RF quadrupoles
[DE91-638997] N92-14827
Differential spot-size focus servo N92-14909
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915

FOOD PROCESSING
Codex general standard for irradiated foods and recommended international code of practice for the operation of radiation facilities used for the treatment of foods
[DE91-632213] N92-14596
Isotopes in everyday life
[DE91-642281] N92-14820

FORECASTING
Terminal area forecasts: FY 1991-2005
[AD-A241489] N92-14005

FORMING TECHNIQUES
The deformation modes of continuous fibre reinforcements in thermoplastic composites during thermoforming: A preliminary hierarchy and geometrical description
[LR-654] N92-14123

FOURIER TRANSFORMATION
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization
[AD-A240857] N92-14180
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437
Fourier transformation in an algebra of generalized functions
[MEMO-954] N92-14730
White light optical fourier transform device
[AD-D015022] N92-14838

FRACTALS
A comparison of the fractal and JPEG algorithms N92-14240
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905

FRACTIONATION
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
FRACTURE MECHANICS
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions [DE91-017690] N92-14387
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture [DE91-638175] N92-14389
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] N92-14397
Mechanical properties of PM aluminium alloys N92-14402
Stress intensity factors for structural details of welded components N92-14407
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410
Delamination onset in polymeric composite laminates under thermal and mechanical loads [NASA-CR-189548] N92-14432
FRACTURE STRENGTH
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys [DE92-000900] N92-14149
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152
Specimens for fatigue and fracture evaluation of metals: FRAG recommendations (first issue) [RAE-TR-91025] N92-14166
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410
Delamination imaging in CFRP laminates N92-14418
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
Delamination onset in polymeric composite laminates under thermal and mechanical loads [NASA-CR-189548] N92-14432
FRACTURING
Grain boundary fracture and alloy design of intermetallics [DE91-018253] N92-14145
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture [DE91-638175] N92-14389
FRAGMENTATION
Phase-space constraints on inclusive energy spectra of heavy ion fragmentation at intermediate energies [DE91-641867] N92-14835
FRAMES
Elastic second-order computer analysis of beam-columns and frames [AD-A241247] N92-14385
FRANCE
Recent progress in inverse methods in France N92-13938
FREE BOUNDARIES
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
FREE CONVECTION
Modelling of the axial-flow gas laser [DE91-635597] N92-14337
FREE ELECTRON LASERS
Photon storage cavities [DE92-000921] N92-14338
Discrete cavity model of a standing-wave free-electron laser [DE92-000839] N92-14340
FREE ELECTRONS
High temperature electronic excitation and ionization rates in gases [NASA-CR-189496] N92-14801
FREE FLOW
Blade design and analysis using a modified Euler solver N92-13952
A boundary integral approach in primitive variables for free surface flows N92-14304
FREE JETS
Particle-laden weakly swirling free jets: Measurements and predictions [NASA-TM-100881] N92-14061
Turbulence measurements in a submerged jet near a free surface N92-14305
FREEZING
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors [DE92-000893] N92-14876
FRENKEL DEFECTS
High energy heavy ion irradiation effect on defect structure of metals [DE91-638281] N92-14146
FREQUENCIES
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
FREQUENCY DISTRIBUTION
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances [MEMO-973] N92-14379
FREQUENCY DIVISION MULTIPLE ACCESS
A reconfigurable multicarrier demodulator architecture N92-14213
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
On-board processing for telecommunications satellites N92-14227
FREQUENCY DIVISION MULTIPLEXING
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
FREQUENCY MEASUREMENT
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
High-frequency P wave spectra from explosions and earthquakes [DE91-018723] N92-14557
FREQUENCY SHIFT KEYING
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030
FREQUENCY STABILITY
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
FREQUENCY STANDARDS
A receiver design for the superconducting cavity-maser oscillator N92-14238
FRESH WATER
Investigations of freshwater and ice surveying using short-pulse radar [AD-A241435] N92-14440
FRESNEL LENSES
Micro-optic lens for data storage N92-14912
FRICTION
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
FRICTION FACTOR
Proceedings of Damping 1991, volume 3 [AD-A241313] N92-14386
FRONTS (METEOROLOGY)
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
FUEL CONSUMPTION
Propellant-remaining modeling N92-14096
FUEL CONTROL
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095
FUEL PRODUCTION
Gas Research Institute experience in solar fuel research N92-14473
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474
FUEL PUMPS
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps [NASA-CR-184263] N92-14344
FUEL TANK PRESSURIZATION
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment [NASA-TM-105372] N92-14323
FUELS
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
FULL SCALE TESTS
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362
FUNCTIONAL DESIGN SPECIFICATIONS
Finite element structural redesign by large admissible perturbations N92-13935
Addressing performance requirements in the FDT based design of distributed systems [MEMO-INF-91-48] N92-14638
FUNCTIONS (MATHEMATICS)
On defining classes of quadratic systems in the plane [REPT-91-32] N92-14735
The algebra of Killing vectors in five-dimensional space [DE91-635976] N92-14765
FUSELAGES
Definition of the unsteady vortex flow over a wing/body configuration [NASA-CR-180083] N92-13995
The two-bay crack problem in fuselages built in GLARE and ARALL [LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage [LR-655] N92-14045
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
FUSES (ORDNANCE)
Pyrofuze aircraft ordnance arming system [AD-D015024] N92-14040
FUSION REACTORS
Conceptual design of D-He-3 FRC reactor ARTEMIS [NIFS-101] N92-14844
ITER diagnostics [DE91-626549] N92-14851
ITER conceptual design activities [DE91-626576] N92-14853
ITER parametric analysis and operational performance [DE91-640901] N92-14861
FUZZY SETS
Some physical applications of nonstandard logical systems [DE91-628005] N92-14707
FUZZY SYSTEMS
A neural network architecture for implementation of expert systems for real time monitoring [NASA-CR-188988] N92-14669

G

GALACTIC COSMIC RAYS
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
GALACTIC STRUCTURE
Empirical population synthesis: New directions N92-14938
GALILEO SPACECRAFT
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
GALLIUM ARSENIDES
Optimal design of solidification processes N92-13944
Enhancing optical absorption in InP and GaAs utilizing profile etching [NASA-TM-105325] N92-14111
Synthesis of mismatched heterojunction/substrate interfaces [AD-A241845] N92-14283
Photovoltaic fundamentals [DE91-015001] N92-14484
Triggering GaAs lock-on switches with laser diode arrays [DE90-013400] N92-14864
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100) [DE92-000868] N92-14872
GAME THEORY
A note on maximal spanning tree games and Prim's algorithm [MEMO-968] N92-14717
GAMMA FUNCTION
Asymptotic inversion of incomplete gamma functions [CWI-AM-R9102] N92-14759
GAMMA RAY OBSERVATORY
Study of geopotential error models used in orbit determination error analysis N92-14083
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
GAMMA RAY SPECTRA
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results [RAE-TM-SPACE-383-PT-1] N92-14099
GAMMA RAYS
GAMUT: A computer code for (gamma)-ray energy and intensity analysis [DE92-000691] N92-14609
Cosmic neutron and gamma quanta detection at balloons [DE91-638485] N92-14960
GAS ANALYSIS
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Whole air sampler N92-14513

GAS COMPOSITION
Analysis of atmospheric spectra for trace gases N92-14532
GAS DYNAMICS
Nonstationary gasdynamics N92-13985
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944
GAS GUNS
Hypersonic aerodynamics N92-13983
GAS JETS
Turbulence measurements in axisymmetric jets of air and helium N92-14299
GAS MIXTURES
Shock waves, implosions and dusty gases N92-13986
GAS TUNGSTEN ARC WELDING
The effects of multiple repairs on Inconel 718 weld mechanical properties
[NASA-TM-103559] N92-14380
GAS TURBINE ENGINES
High temperature static strain gage development
[NASA-CR-189044] N92-14037
Rub induced rotor/stator vibration analysis on CF700 engine
[NRC-TR-ENG-007] N92-14060
GAS TURBINES
Recent progress in inverse methods in France N92-13938
GASEOUS FUELS
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
Gas Research Institute experience in solar fuel research N92-14473
GASES
Upper Atmosphere Data Program (UADP) N92-14553
GASIFICATION
Chemical reactions driven by concentrated solar energy N92-14475
GATES (CIRCUITS)
Insulator assisted self-aligned gate junction
[AD-D014995] N92-14279
GAUGE INVARIANCE
Anisotropic space-time
[DE91-636032] N92-14811
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
Phase space structure in gauge theories
[DE91-623483] N92-14890
GAUGE THEORY
On topological symmetries and the Goldstone Theorem
[DE91-634058] N92-14880
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
Phase space structure in gauge theories
[DE91-623483] N92-14890
GELS
Deformation, fracture and explosive properties of reactive materials
[AD-A241123] N92-14181
GENERAL AVIATION AIRCRAFT
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
FAA statistical handbook of aviation: Calendar year 1989
[PB91-202051] N92-13927
GEOCHEMISTRY
Isotopes in everyday life
[DE91-642281] N92-14820
GEODESY
Inclination functions: Group theoretical background and a recursive algorithm
[REPT-91-2] N92-14115
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
GEODETIC SURVEYS
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560
GEOGRAPHIC INFORMATION SYSTEMS
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
Geographic data modelling in TM
[MEMO-INF-91-53] N92-14640
GEOIDS
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
GEOLOGY
Isotopes in everyday life
[DE91-642281] N92-14820
GEOMAGNETIC PULSATIONS
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
GEOMAGNETISM
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
GEOMETRICAL THEORY OF DIFFRACTION
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263
GEOPHYSICS
Isotopes in everyday life
[DE91-642281] N92-14820
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
GEOPOTENTIAL
Study of geopotential error models used in orbit determination error analysis N92-14083
GIBBS FREE ENERGY
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434
GLIDERS
Review of aerodynamic design in the Netherlands N92-13929
GLOBAL POSITIONING SYSTEM
GPS: Satellite orbits and atmospheric effects
[REPT-91-1] N92-14097
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560
GLUONS
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
GLYCOLS
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282
GODDARD TRAJECTORY DETERMINATION SYSTEM
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
GOVERNMENT PROCUREMENT
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
GOVERNMENTS
Arctic Research of the United States, Volume 5 N92-14562
GRADIENTS
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Inverse problems in diffraction N92-13971
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors
[DE92-000893] N92-14876
GRAIN BOUNDARIES
Grain boundary fracture and alloy design of intermetallics
[DE91-018253] N92-14145
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
GRAMMARS
Increasing the efficiency of an algorithm for solving the problem M(Y,G)
[MEMO-922] N92-14632
GRANTS
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
GRAPH THEORY
A last-fit greedy coloring algorithm for interval graphs
[MEMO-961] N92-14615
The connectivity of the leaf-exchange spanning tree graph of a graph
[MEMO-959] N92-14711
Conceptual data models versus knowledge graphs
[MEMO-962] N92-14712
N-dimensional line digraphs
[MEMO-949] N92-14726
Minimum basis graphs of weighted matroids
[MEMO-950] N92-14727
Hard graphs for the maximum clique problem 2
[MEMO-951] N92-14728
Homomorphisms on n-dimensional line digraphs
[MEMO-952] N92-14729
Collapsing graph models by preorders
[ITLI-ML-91-04] N92-14740
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
GRAPHITE
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites
[NASA-TM-105233] N92-14120
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
GRAPHITE-EPOXY COMPOSITES
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Material property for designing, analyzing, and fabricating space structures
[NASA-CR-189516] N92-14119
Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] N92-14397
Environmental fatigue tests with composite materials N92-14413
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
GRAPHS (CHARTS)
A last-fit greedy coloring algorithm for interval graphs
[MEMO-961] N92-14615
The connectivity of the leaf-exchange spanning tree graph of a graph
[MEMO-959] N92-14711
Conceptual data models versus knowledge graphs
[MEMO-962] N92-14712
N-dimensional line digraphs
[MEMO-949] N92-14726
Hard graphs for the maximum clique problem 2
[MEMO-951] N92-14728
Homomorphisms on n-dimensional line digraphs
[MEMO-952] N92-14729
Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762
GRATINGS (SPECTRA)
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913
GRAVITATION
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560
Discrete anti-gravity
[DE91-011756] N92-14878
GRAVITATION THEORY
Relativistic theory of gravitation based on the constant curvature space
[DE91-636027] N92-14884
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
GRAVITATIONAL COLLAPSE
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
GRAVITATIONAL EFFECTS
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322
GRAVITATIONAL FIELDS
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558

Classical and quantum mechanics of a spinning particle interacting with background fields
[NIKHEF-H/91-06] N92-14823
Relativistic theory of gravitation based on the constant curvature space
[DE91-636027] N92-14884
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946

GRAVITATIONAL WAVES
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946

GRAVITONS
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946

GRAVITY WAVES
Data analysis and archival N92-14551

GRAZING INCIDENCE
Ground wave propagation of a video pulse source, part 2
[DE92-001794] N92-14264

GREASES
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176

GREEN'S FUNCTIONS
Stress intensity factors for structural details of welded components N92-14407

GREENHOUSE EFFECT
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494

GRID GENERATION (MATHEMATICS)
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327
Enhancement of surface definition and gridding in the EAGLE code
[NASA-CR-189445] N92-14607

GROOVES
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361

GROUND BASED CONTROL
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270

GROUND STATE
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147

GROUND STATIONS
Satellite communications for the next generation telecommunication services and networks N92-14207
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949

GROUND SUPPORT EQUIPMENT
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270

GROUND TESTS
Comprehensive MLS testing for category 1, 2, and 3 operation N92-14013

GROUND WAVE PROPAGATION
Ground wave propagation of a video pulse source, part 2
[DE92-001794] N92-14264

GROUND WIND
US Navy regional climatic study of the Barents Sea and adjacent waters
[AD-A241115] N92-14566

GROUP DYNAMICS
A model of the self-explanation effect
[AD-A241200] N92-14684

GROUP THEORY
Inclination functions: Group theoretical background and a recursive algorithm
[REPT-91-2] N92-14115

GUIDANCE (MOTION)
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory
[AD-A241692] N92-14658
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation
[AD-A241697] N92-14663
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664
Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673
Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674
Vision systems for guidance and control: A tutorial overview N92-14679
Advance neural network architectures for guidance and control N92-14682

GUIDANCE SENSORS
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090

GUIDE VANES
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] N92-14319

GYROSCOPES
COBE experience with filter QUEST N92-14078
COBE ground segment gyro calibration N92-14080
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090

GYROSCOPIC STABILITY
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364

H

HADRONS
Z(sup 0) yields hadrons in SDC
[DE92-000294] N92-14800
Space-time structure of hadron interaction
[DE91-623947] N92-14817
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826

HALL EFFECT
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284

HALOGENS
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503

HAMILTON-JACOBI EQUATION
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
Relations between (H infinity) optimal control of a nonlinear system and its linearization
[MEMO-970] N92-14690

HAMILTONIAN FUNCTIONS
Recent developments in the Virasoro master equation
[DE92-000811] N92-14703
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization
[DE91-634069] N92-14704
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749

HANDBOOKS
FAA statistical handbook of aviation: Calendar year 1989
[PB91-202051] N92-13927

HARDNESS
Optimal interaction of indenter with inhomogeneous plate N92-13964

HARDWARE
Architecture for Survivable System Processing (ASSP) N92-14210

HARMONIC EXCITATION
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437

HARMONIC GENERATIONS
Electrical characterization of RF plasmas
[DE92-000822] N92-14863

HASTELLOY (TRADEMARK)
Segregation in welded nickel-base alloys
[DE91-624373] N92-14158

HAZARDS
Waste treatment N92-14456
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458

HEART RATE
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008

HEAT BUDGET
The stratospheric residual circulation as deduced from satellite data N92-14498

HEAT FLUX
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
A 2-D imaging heat-flux gauge
[DE92-000153] N92-14332

HEAT MEASUREMENT
A 2-D imaging heat-flux gauge
[DE92-000153] N92-14332

HEAT PIPES
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174

HEAT PUMPS
Heat pumps for industry
[DE91-015030] N92-14318

HEAT RESISTANT ALLOYS
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168

HEAT SOURCES
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Optimization of the heating surface shape in the contact melting problem N92-13947

HEAT STORAGE
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480

HEAT TRANSFER
Recent progress in inverse methods in France N92-13936
Inverse problems in the design, modeling and testing of engineering systems N92-13966
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174
Assimilation of TIR imagery in numerical models as a tool for water management
[BCRS-90-36] N92-14441
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
Flow boiling with enhancement devices for cold plate coolant channel design
[NASA-CR-189518] N92-14892

HEAT TRANSMISSION
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316

HEAT TREATMENT
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior
[DE92-000899] N92-14164

HEATING
Optimization of the heating surface shape in the contact melting problem N92-13947

HEAVY IONS
High energy heavy ion irradiation effect on defect structure of metals
[DE91-638281] N92-14146
Hydrodynamical analysis of azimuthal two-particle correlations in relativistic heavy-ion collisions
[DE91-637356] N92-14807
Phase-space constraints on inclusive energy spectra of heavy ion fragmentation at intermediate energies
[DE91-641867] N92-14835

HEISENBERG THEORY
Some physical applications of nonstandard logical systems
[DE91-628005] N92-14707
Some physical applications of nonstandard logical systems
[DE91-628004] N92-14887
HELICES
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
HELICOPTER CONTROL
Flight research N92-13981
HELICOPTER DESIGN
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades
[NASA-CR-189018] N92-14038
HELICOPTER PERFORMANCE
Flight research N92-13981
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033
HELICOPTER WAKES
The application of experimental data to blade wake interaction noise prediction
[NASA-CR-189461] N92-14789
HELICOPTERS
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades
[NASA-CR-189018] N92-14038
HELIPORTS
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033
HELIUM
Turbulence measurements in axisymmetric jets of air and helium N92-14299
HELIUM IONS
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849
HELIUM ISOTOPES
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions
[DE92-000825] N92-14814
Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844
HELIUM PLASMA
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
HELMETS
International aviation (selected article)
[AD-A240987] N92-13992
HETEROGENEITY
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
HETEROJUNCTION DEVICES
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
HETEROJUNCTIONS
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
Synthesis of mismatched heterojunction/substrate interfaces
[AD-A241845] N92-14283
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
HEURISTIC METHODS
Formal and heuristic system decomposition methods in multidisciplinary synthesis
[NASA-CR-4413] N92-14041
Addressing performance requirements in the FDT based design of distributed systems
[MEMO-INF-91-48] N92-14638
A framework for test selection
[MEMO-INF-91-54] N92-14753
HIERARCHIES
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
FIDEX: An expert system for satellite diagnostics N92-14218
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
HIGH ALTITUDE
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
HIGH ALTITUDE ENVIRONMENTS
International aviation (selected article)
[AD-A240987] N92-13992
HIGH ENERGY INTERACTIONS
Applications of neural networks in high energy physics
[DE90-013325] N92-14825
HIGH ENERGY PROPELLANTS
Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182
HIGH PRESSURE
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
High pressure fiber optic connector plug
[AD-D015033] N92-14839
HIGH PRESSURE OXYGEN
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
HIGH RESOLUTION
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531
HIGH SPEED
Technology needs for high speed rotorcraft (3)
[NASA-CR-177592] N92-14039
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
HIGH TEMPERATURE
High temperature static strain gage development
[NASA-CR-189044] N92-14037
Performance analysis of advanced spacecraft TPS
[NASA-CR-188694] N92-14098
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
Study of mechanical behavior and internal structure of ferritic nanocrystalline material
[DE92-000760] N92-14162
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
High-temperature photochemistry induced by concentrated solar radiation N92-14457
HIGH TEMPERATURE ENVIRONMENTS
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
HIGH TEMPERATURE GASES
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944
HIGH TEMPERATURE PLASMAS
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862
HIGH TEMPERATURE SUPERCONDUCTORS
Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
Solid state devices N92-14772
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x)
[DE92-000849] N92-14866
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors
[DE91-636318] N92-14870
HIGH VOLTAGES
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
HIGHLANDS
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
HILBERT SPACE
On the sum of two maximal monotone operators, 2
[REPT-91-31] N92-14766
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
HILSCH TUBES
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
HISTOLOGY
Intelligent network management and functional cerebellum synthesis N92-14697
HISTORIES
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Historical perspective on the evolution of avionics standards N92-14049
HODOGRAPHS
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
Design of transonic compressor cascades using hodograph method N92-13973
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974
HOLOGRAPHIC INTERFEROMETRY
Practical design considerations and performance characteristics of high numerical aperture holographic lenses N92-14914
HOMING DEVICES
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
HOMOMORPHISMS
Homomorphisms on n-dimensional line digraphs
[MEMO-952] N92-14729
HORIZON SCANNERS
Colored noise effects on batch attitude accuracy estimates N92-14093
HORSESHOE VORTICES
Parameterization of intermittant turbulence and the vorton method
[DE92-000758] N92-14317
HOT MACHINING
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
HOT PRESSING
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
HOT SURFACES
Optimization of the heating surface shape in the contact melting problem N92-13947
HUBBLE SPACE TELESCOPE
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090
HUBS
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
HULLS (STRUCTURES)
Eighteenth Symposium on Naval Hydrodynamics
[LC-91-62359] N92-14300
HUMAN FACTORS ENGINEERING
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597
HUMAN PERFORMANCE
Synthesis of visual modules from examples: Learning hyperacuity
[AD-A241159] N92-14683
HUMIDITY
Comparison between hot/wet test and RT/dry test on the Seastar horizontal stabilizer and fin N92-14414
HYDRAULIC EQUIPMENT
Hydraulic actuator system for rotor control N92-14363

HYDROCHLORIC ACID
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503

HYDRODYNAMICS
Computational determination of ballistic limits for a simple Whipple bumper shield [NASA-TM-105455] N92-14104
Eighteenth Symposium on Naval Hydrodynamics [LC-91-62359] N92-14300
A coupled time and frequency approach for nonlinear wave radiation N92-14301
Effect of viscous damping on the response of floating bodies N92-14303
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
The flow of plasma in the solar terrestrial environment [NASA-CR-188812] N92-14955

HYDROGEN
High-power hydrogen arcjet performance [NASA-TM-105143] N92-14109
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap [DE91-636586] N92-14857

HYDROGEN ATOMS
Fundamental studies of laser ignition and kinetics in reactive gases [AD-A241463] N92-14334

HYDROGEN CHLORIDES
Insensitive high density explosive [AD-D015026] N92-14183

HYDROGEN FUELS
Fuel processing and thermochemical/photochemical cycles N92-14472

HYDROGEN IONS
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
The new BNL polarized negative ion source [DE92-000134] N92-14799
Laser diagnostics of H(-) formation in a magnetic multicusp ion source [DE92-000940] N92-14815
Ionic composition of plasma and energetic particles in the near-earth cosmic space [DE91-638486] N92-14849

HYDROGEN ISOTOPES
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions [DE92-000825] N92-14814

HYDROGEN MASERS
A receiver design for the superconducting cavity-maser oscillator N92-14238

HYDROGEN OXYGEN ENGINES
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study [NASA-CR-184204] N92-14106

HYDROGEN PEROXIDE
Chemical models of advanced oxidation processes N92-14447
Ultrox operating experiences with UV/oxidation; economics N92-14451

HYDROGEN PRODUCTION
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474

HYDROLOGY
Isotopes in everyday life [DE91-642281] N92-14820

HYDROXYL EMISSION
Radio frequency investigations of the interstellar medium N92-14936

HYDROXYL RADICALS
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Laboratory spectroscopy in support of atmospheric measurements N92-14528

HYPERCUBE MULTIPROCESSORS
Network orientation [RUU-CS-91-8] N92-14667

HYPERPLANES
Point location in zones of k-flats in arrangements [RUU-CS-91-9] N92-14769

HYPERSONIC FLOW
Numerical investigations in three-dimensional internal flows [NASA-CR-189467] N92-14313

HYPERSONIC SPEED
History of EPOS air-launched spaceplane project N92-14103

HYPERSONIC VEHICLES
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
Numerical investigations in three-dimensional internal flows [NASA-CR-189467] N92-14313

HYPERSONIC WIND TUNNELS
Hypersonic aerodynamics N92-13983

HYPERSONICS
Activities of the University of Toronto Institute for Aerospace Studies [CTN-91-60222] N92-13975
Numerical investigations in three-dimensional internal flows [NASA-CR-189467] N92-14313

HYPERVELOCITY GUNS
Hypersonic aerodynamics N92-13983

HYPERVELOCITY LAUNCHERS
Hypervelocity launch capabilities to over 10 km/s [DE92-000242] N92-14377

HYSTERESIS
Development of instrumentation for magnetic nondestructive evaluation [DE92-000152] N92-14381

I

ICE
LEWICE/E: An Euler based ice accretion code [NASA-TM-105389] N92-14001
Investigations of freshwater and ice surveying using short-pulse radar [AD-A241435] N92-14440

ICE CLOUDS
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
Airborne aerosol lidar N92-14519

ICE FORMATION
LEWICE/E: An Euler based ice accretion code [NASA-TM-105389] N92-14001

IGNITION
Fundamental studies of laser ignition and kinetics in reactive gases [AD-A241463] N92-14334
ITER parametric analysis and operational performance [DE91-640901] N92-14861

ILLUMINATING
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990 [PB91-910405] N92-14006
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation [DE92-000859] N92-14341

ILLUMINATION
Effect of light intensity on photocatalytic reaction N92-14449

IMAGE ANALYSIS
Radar vision N92-14026
Image-based ranging and guidance for rotorcraft [NASA-CR-184829] N92-14036
Water vapor imagery: Interpretation and applications to weather analysis and forecasting [NOAA-TR-NESDIS-57] N92-14565
Pattern recognition in pulmonary computerized tomography images using Markovian modeling [TELECOM-PARIS-91-C-002] N92-14584
Analysis of objects in binary images [NASA-CR-4420] N92-14598
Convergence, continuity and iteration in mathematical morphology [CWI-BS-R9104] N92-14743
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data [DLR-FB-91-06] N92-14959

IMAGE PROCESSING
Image-supported navigation for testing instrument landing systems N92-14012
Radar vision N92-14026
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
The matching of doubly ambiguous stereograms [AD-A241251] N92-14587
Analysis of objects in binary images [NASA-CR-4420] N92-14598
Two-dimensional adaptive enhancement and detection of linear features in noisy images [DE92-000982] N92-14613
Recognition of overlapping objects using Markov spatial processes [CWI-BS-R9109] N92-14763
Custom microcircuits N92-14775
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905

IMAGE RECONSTRUCTION
Comparison of four stable numerical methods for Abel's integral equation N92-13946
A comparison of the fractal and JPEG algorithms N92-14240

IMAGE RESOLUTION
Synthesis of visual modules from examples: Learning hyperacuity [AD-A241159] N92-14683

IMAGING TECHNIQUES
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
Thermal wave imaging examples and applications [AD-A240982] N92-14124
A 2-D imaging heat-flux gauge [DE92-000153] N92-14332
Analysis of objects in binary images [NASA-CR-4420] N92-14598
Solar x ray astronomy rocket program [NASA-CR-183494] N92-14935

IMMUNE SYSTEMS
Electromagnetic field effects on cells of the immune system: The role of calcium signalling [DE92-000852] N92-14583

IMPACT LOADS
Application of MSC/DYNA to shock and impact problems in aircraft industry [MBB-UD-0593-91-PUB] N92-14382

IMPACT STRENGTH
Analysis of the optimal laminated target made up of discrete set of materials N92-13965

IMPACT TESTS
Computational determination of ballistic limits for a simple Whipple bumper shield [NASA-TM-105455] N92-14104
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield [NASA-TM-105456] N92-14105
Deformation, fracture and explosive properties of reactive materials [AD-A241123] N92-14181
Delamination imaging in CFRP laminates N92-14418

IMPACT TOLERANCES
Development of a new design method to predict impact damage tolerance of composite structures N92-14416

IMPEDANCE
Transfer impedance of coaxial cables [DE91-018411] N92-14273

IMPELLERS
Study of a new airfoil used in reversible axial fans N92-13970
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359

IMPLANTATION
Vanadium and tantalum frequency spectrum deformation by interstitial impurities [DE91-623605] N92-14160

IMPLOSIONS
Shock waves, implosions and dusty gases N92-13986

IMPROVEMENT
Avionics modernization/upgrades in the late 1990s N92-14055

IMPURITIES
A review of positive ion sensitivities for the SIMS analysis of CMT [RSRE-91015] N92-14139

INCENTIVES
Capital investment in semiconductors: The lifeblood of the US semiconductor industry [PB91-165902] N92-14272

INCINERATORS
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458

INCOMPRESSIBLE FLOW
Adjoint operator approach to shape design for internal incompressible flows N92-13957
An inverse method with regularity condition for transonic airfoil design N92-13969
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] N92-14321

INCOMPRESSIBLE FLUIDS
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] N92-14328
INCONEL (TRADEMARK)
Segregation in welded nickel-base alloys [DE91-624373] N92-14158
The effects of multiple repairs on Inconel 718 weld mechanical properties [NASA-TM-103559] N92-14380
INDENTATION
Optimal interaction of indenter with inhomogeneous plate N92-13964
Analysis of the optimal laminated target made up of discrete set of materials N92-13965
INDEPENDENT VARIABLES
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085
INDEXES (DOCUMENTATION)
Program/project management initiative: NASA library project management collection [NASA-TM-105453] N92-14898
INDIAN OCEAN
Satellite remote sensing of large scale ocean transients [AD-A241122] N92-14574
INDIUM COMPOUNDS
Synthesis of mismatched heterojunction/substrate interfaces [AD-A241845] N92-14283
INDIUM PHOSPHIDES
Enhancing optical absorption in InP and GaAs utilizing profile etching [NASA-TM-105325] N92-14111
INDUCTION (MATHEMATICS)
Induced circuits in planar graphs [CWI-BS-R9106] N92-14744
INDUSTRIES
Capital investment in semiconductors: The lifeblood of the US semiconductor industry [PB91-165902] N92-14272
INELASTIC COLLISIONS
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
INELASTIC SCATTERING
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
New parametrization of multiplicity distribution in pp and p(-p) inelastic interactions [DE91-637100] N92-14805
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions [DE92-000825] N92-14814
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9) [DE91-636317] N92-14869
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors [DE91-636318] N92-14870
INERTIA
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
INERTIAL NAVIGATION
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087
INFINITY
State space formulas for transfer poles at infinity [CWI-BS-R9108] N92-14748
INFORMATION DISSEMINATION
Program/project management initiative: NASA library project management collection [NASA-TM-105453] N92-14898
INFORMATION MANAGEMENT
Data analysis and archival N92-14551
Rebels in search of champions: Envisioning the library of the future [DE91-016606] N92-14900
INFORMATION PROCESSING (BIOLOGY)
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989 [NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
Intelligent network management and functional cerebellum synthesis N92-14697
INFORMATION RETRIEVAL
Satellite remote sensing of large scale ocean transients [AD-A241122] N92-14574
Lies, damned lies, and databases [RSRE-MEMO-4503] N92-14917
INFORMATION SYSTEMS
Historical perspective on the evolution of avionics standards N92-14049
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
Architecture for Survivable System Processing (ASSP) N92-14210
An engineering approach to ODP systems design [MEMO-INF-91-49] N92-14600
An example machine used for developing a proof strategy for secure systems [RSRE-91022] N92-14627
Theoretical foundations for information representation and constraint specification [AD-A241842] N92-14899
Rebels in search of champions: Envisioning the library of the future [DE91-016606] N92-14900
INFORMATION THEORY
Some physical applications of nonstandard logical systems [DE91-628004] N92-14887
INFORMATION TRANSFER
Standard formatted data units-control authority operations [NASA-CR-188748] N92-14896
Standard formatted data units-control authority procedures [NASA-CR-188127] N92-14897
Theoretical foundations for information representation and constraint specification [AD-A241842] N92-14899
INFRARED IMAGERY
Assimilation of TIR imagery in numerical models as a tool for water management [BCRS-90-36] N92-14441
INFRARED INSTRUMENTS
Infrared measurements of atmospheric constituents N92-14501
INFRARED RADIATION
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080
Infrared measurements of atmospheric constituents N92-14501
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
INFRARED SPECTRA
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
INFRARED SPECTROSCOPY
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization [AD-A240857] N92-14180
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution [AD-A241797] N92-14282
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
INFRASONIC FREQUENCIES
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion [AD-A241316] N92-14793
INHIBITORS
Inhibitor and barrier for use with high energy rocket propellants [AD-D015023] N92-14182
INHOMOGENEITY
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal [DE91-636636] N92-14858
INJECTORS
Coaxial injector spray characterization using water/air as simulants [NASA-TM-105322] N92-14112
High-brightness injectors for hadron colliders [DE92-000208] N92-14826
INLET FLOW
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
Numerical investigations in three-dimensional internal flows [NASA-CR-189467] N92-14313
INLET PRESSURE
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354
INPUT
Equivalence of nonlinear systems to input-output prime forms [MEMO-975] N92-14752
INSPECTION
MLS testing using built-in test N92-14024
A concept for the revisions of structural inspection schedules N92-14431
INSTANTONS
Quarks in the instanton vacuum. 1: Quark propagator [DE91-637129] N92-14806
INSTRUMENT ERRORS
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
INSTRUMENT LANDING SYSTEMS
Image-supported navigation for testing instrument landing systems N92-14012
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a [ACD-340] N92-14034
INTAKE SYSTEMS
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics [NASA-TM-105321] N92-13998
INTEGRAL EQUATIONS
Comparison of four stable numerical methods for Abel's integral equation N92-13946
Generalizing multiquadratic interpolation: Univariate case [MEMO-974] N92-14718
INTEGRALS
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085
INTEGRATED CIRCUITS
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS [DE92-000998] N92-14378
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation [AD-A241697] N92-14663
Photonics N92-14773
INTEGRATED OPTICS
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915
INTELLIGIBILITY
On the proofs of arithmetical completeness for interpretability logic [ITLI-ML-91-03] N92-14739
INTELSAT SATELLITES
On-board processing for telecommunications satellites N92-14227
A B-ISDN-compatible modem/codec N92-14229
INTERACTIONAL AERODYNAMICS
Intelligent Robotic Systems Study (IRSS), phase 3 [NASA-CR-184261] N92-14671
INTERCALATION
Properties of novel CVD graphite fibers and their bromine intercalation compounds [NASA-TM-105295] N92-14170
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x) [DE92-000849] N92-14866
INTERFACES
Theoretical and experimental investigation of heterojunction interfaces [AD-A241243] N92-14278
INTERFEROMETERS
High spectral resolution measurements for the ARM Program [DE92-000765] N92-14493
INTERMETALLICS
Grain boundary fracture and alloy design of intermetallics [DE91-018253] N92-14145
Slip, twinning and transformation in Laves phases [DE92-000764] N92-14163
INTERMITTENCY
Parameterization of intermittant turbulence and the vorton method [DE92-000758] N92-14317
INTERNAL WAVES
Data analysis and archival N92-14551

INTERNATIONAL COOPERATION
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
INTERNATIONAL LAW
Antarctic news clips, 1991
[NSF-91-79] N92-14561
INTERPLANETARY MAGNETIC FIELDS
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
INTERPLANETARY NAVIGATION
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249
INTERPOLATION
Computational fluid dynamics N92-13979
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713
On approximation and interpolation of convex functions
[MEMO-967] N92-14716
Generalizing multiquadratic interpolation: Univariate case
[MEMO-974] N92-14718
Derivative generation in piecewise cubic C(1)-interpolation
[MEMO-976] N92-14719
On radial spline interpolation
[MEMO-948] N92-14725
INTERPROCESSOR COMMUNICATION
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration
[AD-A241696] N92-14662
INTERROGATION
Testing MLS DME/P transponders and interrogators N92-14020
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
INTERSTELLAR GAS
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944
INTERSTELLAR MASERS
Radio frequency investigations of the interstellar medium N92-14936
INTERSTELLAR MATTER
Radio frequency investigations of the interstellar medium N92-14936
INTERSTITIALS
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160
INTERVALS
A last-fit greedy coloring algorithm for interval graphs
[MEMO-961] N92-14615
INVARIANCE
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
The algebra of Killing vectors in five-dimensional space
[DE91-635976] N92-14765
Antiparticles
[DE91-636031] N92-14810
Discrete anti-gravity
[DE91-011756] N92-14878
INVERSE SCATTERING
Potential reconstruction from R-matrix resonance positions and reduced widths
[DE91-628029] N92-14708
Generalization of traveltime inversion
[REPT-91-13] N92-14733
INVERSIONS
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth
[DLR-FB-91-07] N92-14571
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759
INVISCID FLOW
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
IODINE COMPOUNDS
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x)
[DE92-000849] N92-14866
IODINE LASERS
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
ION BEAMS
Applications of energetic particles in improving coating adhesion properties N92-14461
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
ION DENSITY (CONCENTRATION)
Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field
[DE91-623737] N92-14859
ION EMISSION
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
ION IMPLANTATION
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy
[DE92-000734] N92-14155
ION IRRADIATION
High energy heavy ion irradiation effect on defect structure of metals
[DE91-638281] N92-14146
ION SOURCES
The new BNL polarized negative ion source
[DE92-000134] N92-14799
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
ION TEMPERATURE
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field
[DE91-623737] N92-14859
IONIC COLLISIONS
Hydrodynamical analysis of azimuthal two-particle correlations in relativistic heavy-ion collisions
[DE91-637356] N92-14807
IONIZING RADIATION
Ionizing radiation survey
[AD-A240966] N92-14253
Custom microcircuits N92-14775
IONOSPHERIC ELECTRON DENSITY
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers
[DE91-635168] N92-14556
IONOSPHERIC SOUNDING
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
IONS
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950
IRON
Study of mechanical behavior and internal structure of ferritic nanocrystalline material
[DE92-000760] N92-14162
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429
Characterization of magneto-optical media N92-14903
IRRADIANCE
Measurement of the absolute solar UV irradiance and variability N92-14522
IRRADIATION
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
Codex general standard for irradiated foods and recommended international code of practice for the operation of radiation facilities used for the treatment of foods
[DE91-632213] N92-14596
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841
IRREVERSIBLE PROCESSES
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132
ISING MODEL
Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
ISOMORPHISM
N-dimensional line digraphs
[MEMO-949] N92-14726
Hard graphs for the maximum clique problem 2
[MEMO-951] N92-14728
ISOTOPES
Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry
[DE91-018610] N92-14127
Isotopes in everyday life
[DE91-642281] N92-14820
ISOTOPIC LABELING
Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry
[DE91-018610] N92-14127
ITERATION
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
Projected quasi-Newton updates
[MATHS-REPT-A-144] N92-14605
ITERATIVE SOLUTION
Blade design and analysis using a modified Euler solver N92-13952
IVORY COAST
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443

J

JACKETS
High pressure fiber optic connector plug
[AD-D015033] N92-14839
JAMMING
Adaptive optical processor
[AD-A241535] N92-14837
JAPAN
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
JET AIRCRAFT
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008
JET AIRCRAFT NOISE
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Jet noise suppression N92-14784
Quiet aircraft design and operational characteristics N92-14787
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788
JET ENGINES
Recent progress in inverse methods in France N92-13938
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics
[NASA-TM-105321] N92-13998
Stability of intershaft squeeze film dampers N92-14351
JET EXHAUST
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788
JET FLOW
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
JET MIXING FLOW
Jet noise suppression N92-14784
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795
JET STREAMS (METEOROLOGY)
Analysis of troposphere-stratosphere exchange N92-14552
JFET
Insulator assisted self-aligned gate junction
[AD-D014995] N92-14279
JOURNAL BEARINGS
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362

Fluid compressibility effects on the dynamic response of hydrostatic journal bearings N92-14372
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373

K

K-EPSILON TURBULENCE MODEL
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795
KALMAN FILTERS
New quests for better attitudes N92-14077
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
KAPTON (TRADEMARK)
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces
[NASA-TM-105363] N92-14114
KELVIN-HELMHOLTZ INSTABILITY
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858
KERR MAGNETOOPTICAL EFFECT
Characterization of magneto-optical media N92-14903
KINETIC ENERGY
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
KINETICS
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
KNOWLEDGE REPRESENTATION
Dialogue structuring
[REPT-90-89] N92-14644
Conceptual data models versus knowledge graphs
[MEMO-962] N92-14712
KOLMOGOROFF THEORY
Combinatorial properties of finite sequences with high Kolomogorov complexity
[ITLI-CT-91-09] N92-14754
KORTEWEG-DEVRIES EQUATION
Riccati and soliton equations
[CWI-AM-R9103] N92-14742
KRYPTON FLUORIDE LASERS
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
KUTTA-JOUKOWSKI CONDITION
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999

L

LABYRINTH SEALS
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
LAGRANGE MULTIPLIERS
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
LAMINAR BOUNDARY LAYER
Aeroacoustics N92-13976
LAMINAR FLOW
Adjoint operator approach to shape design for internal incompressible flows N92-13957
LAMINAR WAKES
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315
LAMINATES
Analysis of the optimal laminated target made up of discrete set of materials N92-13965
Structural mechanics and materials science N92-13989
The two-bay crack problem in fuselages built in GLARE and ARALL
[LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
Fatigue of repaired composite structures N92-14411
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
Delamination imaging in CFRP laminates N92-14418
Static and dynamic strength of joints in ARALL-laminates N92-14423
Delamination onset in polymeric composite laminates under thermal and mechanical loads
[NASA-CR-189548] N92-14432
LANDING GEAR
Optimization of the calculation margins of landing gears under extreme loads. Rupture static tests. Part 1: Program and test implantation
[CEAT-S8-6551-PARTIEL-1-PT-1] N92-14043
LANTHANUM COMPOUNDS
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
LAP JOINTS
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422
LAPLACE TRANSFORMATION
A continuous polling system with general service times
[MEMO-971] N92-14750
LARGE SPACE STRUCTURES
Structural mechanics and materials science N92-13989
Material property for designing, analyzing, and fabricating space structures
[NASA-CR-189516] N92-14119
LASER ALTIMETERS
Streak camera receiver definition study
[NASA-CR-189251] N92-14330
LASER ANNEALING
Pulsed laser processing of solar cells N92-14462
LASER APPLICATIONS
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
Fundamentals of metals joining with lasers
[DE92-000789] N92-14156
Potential industrial applications of photons N92-14471
LASER BEAMS
Solar pumped lasers: Work in progress at the University of Chicago N92-14466
Laser beam modeling in optical storage systems N92-14911
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915
LASER CAVITIES
Photon storage cavities
[DE92-000921] N92-14338
LASER HEATING
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
LASER INDUCED FLUORESCENCE
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
LASER MATERIALS
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
Solar pumped lasers: Work in progress at the University of Chicago N92-14466
LASER OUTPUTS
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
Sources of noise in magneto-optical readout N92-14908
Measurement of laser spot quality N92-14910
LASER PUMPING
Solar pumping of lasers N92-14465
LASER RANGE FINDERS
Streak camera receiver definition study
[NASA-CR-189251] N92-14330
LASER SPECTROSCOPY
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
LASER TARGET INTERACTIONS
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
LASER WELDING
SNL initiatives in electronic fluxless soldering
[DE92-000818] N92-14188
LASERS
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
LATTICE VIBRATIONS
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors
[DE91-636318] N92-14870
LATTICES (MATHEMATICS)
Riccati and soliton equations
[CWI-AM-R9103] N92-14742
Convergence, continuity and iteration in mathematical morphology
[CWI-BS-R9104] N92-14743
LAUNCH VEHICLES
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study
[NASA-CR-184204] N92-14106
LEAD ALLOYS
A novel phase transition in alloys
[DE92-000366] N92-14161
LEADING EDGES
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995
LEAF AREA INDEX
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
LEARNING
Neural network paradigms N92-14675
Education stimulation project COO for A30-CT
[REPT-90-87] N92-14893
LEARNING THEORY
A model of the self-explanation effect
[AD-A241200] N92-14684
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
LEAST SQUARES METHOD
New quests for better attitudes N92-14077
Colored noise effects on batch attitude accuracy estimates N92-14093
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Rational approximations to fluid properties
[DE90-012531] N92-14297

LENGTH
Basic procedure of measuring the relativistic length and its modifications
[DE91-628072] N92-14260
LENS DESIGN
Micro-optic lens for data storage N92-14912
LENSES
Practical design considerations and performance characteristics of high numerical aperture holographic lenses N92-14914
LEPTONS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
Antiparticles
[DE91-636031] N92-14810
Phase space structure in gauge theories
[DE91-623483] N92-14890
LEVITATION
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
LIBRARIES
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
Rebels in search of champions: Envisioning the library of the future
[DE91-016606] N92-14900
LIBRATION
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth + Moon elliptic restricted three-body problem
[AD-A241690] N92-14069
LIE GROUPS
Recent developments in the Virasoro master equation
[DE92-000811] N92-14703
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization
[DE91-634069] N92-14704
New examples of continuum graded Lie algebras
[DE91-623480] N92-14709
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group
[DE91-623503] N92-14710
Phase space structure in gauge theories
[DE91-623483] N92-14890
LIFE (DURABILITY)
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
LIFE SCIENCES
Antarctic news clips, 1991
[NSF-91-79] N92-14561
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-019] N92-14577
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-020] N92-14578
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-021] N92-14579
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-022] N92-14580
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-023] N92-14581
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-024] N92-14582
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929
LIFE SUPPORT SYSTEMS
Clean room survey and assessment, volume 5, appendix H
[NASA-CR-184251] N92-14594
LIFT
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997
LIFT DRAG RATIO
On a global aerodynamic optimization of a civil transport aircraft N92-13931
LIFTING BODIES
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
LIGHT CURVE
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937
LIGHT EMITTING DIODES
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864
LIGHT GAS GUNS
Nonstationary gasdynamics N92-13985
LIGHT SOURCES
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864
LIGHT TRANSMISSION
The techniques of optical fibre measurements: An overall description
[DE91-635892] N92-14840
LIGHTNING
Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE-1] N92-14007
LINE OF SIGHT
Improved accuracies for satellite tracking N92-14086
LINE SPECTRA
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
LINEAR ACCELERATORS
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826
To acceleration and focusing theory in RF quadrupoles
[DE91-638997] N92-14827
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
LINEAR EQUATIONS
Education stimulation project COO for A30-CT
[REPT-90-87] N92-14893
LINEAR PROGRAMMING
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769
LINEAR QUADRATIC GAUSSIAN CONTROL
Finite-dimensional robust controller designs for distributed parameter systems: A survey
[W-9104] N92-14699
LINEAR SYSTEMS
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693
State space formulas for transfer poles at infinity
[CWI-BS-R9108] N92-14748
LINEARIZATION
Levationis Laus
[ITLI-CT-91-08] N92-14622
Relations between (H infinity) optimal control of a nonlinear system and its linearization
[MEMO-970] N92-14690
Further results in the triangular decoupling problem for nonlinear systems
[MEMO-941] N92-14724
Riccati and soliton equations
[CWI-AM-R9103] N92-14742
LINES (GEOMETRY)
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
LINKS (MATHEMATICS)
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
LIQUID ATOMIZATION
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112
LIQUID BEARINGS
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375
LIQUID CHROMATOGRAPHY
Viscometry constants for 1,4 polybutadiene in tetralin at 135C
[AD-A241843] N92-14125
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
LIQUID HYDROGEN
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
LIQUID METAL FAST BREEDER REACTORS
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
LIQUID PROPELLANT ROCKET ENGINES
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
LIQUID ROCKET PROPELLANTS
Propellant-remaining modeling N92-14096
LIQUID SLOSHING
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
LIQUID SURFACES
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375
LIQUID-GAS MIXTURES
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
LIQUID-VAPOR INTERFACES
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
LIQUIDS
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322
LITHIUM ALLOYS
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys
[DE92-000900] N92-14149
LITHIUM CHLORIDES
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
LITHIUM FLUORIDES
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
LITHIUM OXIDES
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
LITHOSPHERE
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
LOAD DISTRIBUTION (FORCES)
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
LOAD TESTS
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429
LOADS (FORCES)
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
The effect of overloads on life-time N92-14430

Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437

LOGARITHMS
A hyperelliptic diophantine equation related to imaginary quadratic number fields with class number 2
[MEMO-978] N92-14617
Scale sensitivity and rank preservation in a multiplicative variant of the analytic hierarchy process
[REPT-91-20] N92-14758

LOGIC CIRCUITS
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619

LOGIC DESIGN
The incomplete database
[ITLI-CT-91-07] N92-14722

LOGIC PROGRAMMING
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619
Levationis Laus
[ITLI-CT-91-08] N92-14622
Constructive fixpoint semantics for truth maintenance systems
[REPT-90-85] N92-14641
Constructive identification with Poole's default logic
[REPT-90-86] N92-14642
Dialogue structuring
[REPT-90-89] N92-14644
A fully abstract model for concurrent constraint programming
[RUU-CS-91-10] N92-14651
The incomplete database
[ITLI-CT-91-07] N92-14722
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919

LOOPS
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852

LORENTZ TRANSFORMATIONS
Anisotropic space-time
[DE91-636032] N92-14811

LOW ASPECT RATIO WINGS
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996

LOW COST
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209

LOW GRAVITY MANUFACTURING
Materials processing in space N92-13984

LOW NOISE
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531

LOW REYNOLDS NUMBER
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315

LOW TEMPERATURE
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872

LOW TEMPERATURE TESTS
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material
[DE92-000927] N92-14152

LUBRICANTS
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375

LUBRICATING OILS
Filter debris analysis: A concrete approach to wear diagnosis
[DREP-TM-88-20] N92-14345

LUMINOSITY
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830

LUMINOUS INTENSITY
Effect of light intensity on photocatalytic reaction N92-14449

LUNAR BASES
Thermochemical energy storage for a lunar base
[NASA-TM-105333] N92-14485

LUNAR EXPLORATION
Nuclear technologies for Moon and Mars exploration
[DE91-018832] N92-14951

LUNAR PROGRAMS
JPRS report: Science and technology. USSR: Space. Mishin monograph on failure of Soviet manned lunar program
[JPRS-USP-91-006] N92-14068

LUNAR ROCKS
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480

LUNAR SOIL
Thermochemical energy storage for a lunar base
[NASA-TM-105333] N92-14485

M

MACH NUMBER
Blade design and analysis using a modified Euler solver N92-13952
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
Numerical investigations in three-dimensional internal flows
[NASA-CR-189467] N92-14313

MACH-ZEHNDER INTERFEROMETERS
Fiber optic smart structures N92-13980

MACHINE TOOLS
CNC water-jet machining and cutting center
[DE92-000661] N92-14187

MACHINE TRANSLATION
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal
[RSRE-91014] N92-14624

MACHINERY
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360

MAGELLANIC CLOUDS
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945

MAGNETIC BEARINGS
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369

MAGNETIC COILS
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291

MAGNETIC DIPOLES
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906

MAGNETIC DOMAINS
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907

MAGNETIC FIELDS
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle
[NASA-CR-189090] N92-14436
Magnetic field in the end region of the SSC quadrupole magnet
[DE92-000850] N92-14778
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field
[DE91-623737] N92-14859

MAGNETIC LEVITATION VEHICLES
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933

MAGNETIC MEASUREMENT
Development of a calibration method for deepsea magnetic particle testing N92-14196
Testing a force sensor for underwater magnetic particle inspection N92-14197
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381

MAGNETIC MIRRORS
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855

MAGNETIC MONOPOLES
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group
[DE91-623503] N92-14710

MAGNETIC PROPERTIES
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

MAGNETIZATION
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904

MAGNETO-OPTICS
Research studies on advanced optical module/head designs for optical devices
[NASA-CR-189756] N92-14902
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907
Sources of noise in magneto-optical readout N92-14908
Laser beam modeling in optical storage systems N92-14911
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913

MAGNETOHYDRODYNAMIC FLOW
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955

MAGNETOHYDRODYNAMIC GENERATORS
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862

MAGNETOHYDRODYNAMIC STABILITY
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field
[DE91-623737] N92-14859

MAGNETOHYDRODYNAMIC WAVES
New non-axisymmetric eigenmodes associated with an edge plasma layer
[DE90-798727] N92-14843
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845

MAGNETOHYDRODYNAMICS
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955

MAGNETOMETERS
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090
NASA Marshall Space Flight Center solar observatory report, January - June 1991
[NASA-TM-103555] N92-14958

MAGNETOPAUSE
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496

MAGNETORESISTIVITY
Characterization of magneto-optical media
N92-14903
MAGNETOSHEATH
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849
MAGNETRONS
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
MAINTENANCE
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
MAN-COMPUTER INTERFACE
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Dialogue structuring
[REPT-90-89] N92-14644
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685
MANAGEMENT INFORMATION SYSTEMS
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649
Standard formatted data units-control authority operations
[NASA-CR-188748] N92-14896
Standard formatted data units-control authority procedures
[NASA-CR-188127] N92-14897
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
MANAGEMENT METHODS
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
MANAGEMENT PLANNING
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
MANAGEMENT SYSTEMS
Evaluating the operations capability of Freedom's Data Management System
[NASA-CR-187315] N92-14894
MANGANESE
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
MANIFOLDS (MATHEMATICS)
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
On radial spline interpolation
[MEMO-948] N92-14725
MANIPULATORS
Underwater Technology Symposium
[VTT-120] N92-14190
Tool exchanger for underwater use N92-14198
Optical proximity sensor for underwater manipulator applications N92-14199
Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671
Intelligent Robotic Systems Study (IRSS), phase 4
[NASA-CR-184262] N92-14672
Adaptive PD+ control of rigid robot manipulators
[MEMO-958] N92-14692
MANNED MARS MISSIONS
Nuclear technologies for Moon and Mars exploration
[DE91-018832] N92-14951
MANNED SPACE FLIGHT
JPRS report: Science and technology. USSR: Space. Mishin monograph on failure of Soviet manned lunar program
[JPRS-USP-91-006] N92-14068
MANPOWER
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597
MANUALS
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
MANUFACTURING
International aviation (selected article)
[AD-A240986] N92-13991
MAPPING
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
On the symbolic calculation of periodic orbits for the logistic map
[MEMO-965] N92-14715
MARANGONI CONVECTION
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322
MARINE ENVIRONMENTS
US Navy regional climatic study of the Barents Sea and adjacent waters
[AD-A241115] N92-14566
MARINE TRANSPORTATION
Electronic systems in transportation
[TP-9983] N92-14009
MARKOV CHAINS
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
MARKOV PROCESSES
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584
A new device for the synthesis problem of optimal control of admission to an M/M/c queue
[CWI-BS-R9101] N92-14698
Random additive functionals with rapid Markov switchings
[CWI-AM-R9104] N92-14760
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
MARS PROBES
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
MARS SATELLITES
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249
MARTINGALES
Random additive functionals with rapid Markov switchings
[CWI-AM-R9104] N92-14760
MASERS
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
MASS SPECTROSCOPY
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126
Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry
[DE91-018610] N92-14127
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139
MASS TRANSFER
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
MASSIVELY PARALLEL PROCESSORS
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
Advanced computing N92-14774
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys
N92-14906
MATCHED FILTERS
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey
N92-14251
Investigations of freshwater and ice surveying using short-pulse radar
[AD-A241435] N92-14440
MATERIALS SCIENCE
JPRS report: Science and technology. USSR: Materials science
[JPRS-UMS-91-008] N92-14143
MATHEMATICAL LOGIC
History of constructivism in the twentieth century
[ITLI-ML-91-05] N92-14599
Definition of reusable concurrent software components
[REPT-90-066] N92-14606
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634
Constructive identification with Poole's default logic
[REPT-90-86] N92-14642
Some physical applications of nonstandard logical systems
[DE91-628005] N92-14707
The incomplete database
[ITLI-CT-91-07] N92-14722
On the metamathematics of weak theories
[ITLI-ML-91-02] N92-14738
On the proofs of arithmetical completeness for interpretability logic
[ITLI-ML-91-03] N92-14739
Collapsing graph models by preorders
[ITLI-ML-91-04] N92-14740
MATHEMATICAL MODELS
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
On designing for quality N92-13963
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Space robotics N92-13987
MLS system error model identification and synthesis
N92-14015
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
Propellant-remaining modeling N92-14096
Bandwidth-limited robust nonlinear spacecraft control
N92-14100
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265
Rational approximations to fluid properties
[DE90-012531] N92-14297
A boundary integral approach in primitive variables for free surface flows N92-14304
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] N92-14326
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337
Discrete cavity model of a standing-wave free-electron laser
[DE92-000839] N92-14340
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances
[MEMO-973] N92-14379
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
Assimilation of TIR imagery in numerical models as a tool for water management
[BCRS-90-36] N92-14441
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
Airborne aerosol lidar N92-14519
CDFTBL: A statistical program for generating cumulative distribution functions from data
[DE92-002106] N92-14614
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671

Generalization of traveltime inversion
[REPT-91-13] N92-14733
Second order wave forces and wave drift damping
[REPT-91-34] N92-14736
Theoretical models for duct acoustic propagation and radiation N92-14782
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919
Rotating relativistic neutron stars
[DE92-000806] N92-14941

MATHEMATICAL PROGRAMMING
Practical computational complexity
[RSRE-MEMO-4468] N92-14628

MATHEMATICS
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-007] N92-14776
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-006] N92-14777

MATRICES (MATHEMATICS)
Improved selection in totally monotone arrays
[DE92-000817] N92-14610
Scaling properties of band random matrices
[DE91-635977] N92-14705
Potential reconstruction from R-matrix resonance positions and reduced widths
[DE91-628029] N92-14708
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834

MATRIX MATERIALS
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415

MATRIX METHODS
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347

MATTER (PHYSICS)
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

MAXIMUM ENTROPY METHOD
Empirical population synthesis: New directions N92-14938

MAXIMUM LIKELIHOOD ESTIMATES
New quests for better attitudes N92-14077
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757

MEAN SQUARE VALUES
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761

MEASURING INSTRUMENTS
Response level of precipitation sensors
[ETN-92-90311] N92-14573
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862

MECHANICAL DRIVES
Converting a commercial electric direct-drive robot to operate from joint torque commands
[DE92-000611] N92-14687

MECHANICAL PROPERTIES
Optimization of the calculation margins of landing gears under extreme loads. Rupture static tests. Part 1: Program and test implantation
[CEAT-S8-6551-PARTIEL-1-PT-1] N92-14043
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168
Mechanical properties of PM aluminium alloys N92-14402
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877

MECHANICAL SHOCK
Application of MSC/DYNA to shock and impact problems in aircraft industry
[MBB-UD-0593-91-PUB] N92-14382

MELTING
Optimization of the heating surface shape in the contact melting problem N92-13947
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167

MELTS (CRYSTAL GROWTH)
Optimization of the heating surface shape in the contact melting problem N92-13947

MEMBRANES
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169
Design of the support structure, drive pedestal, and controls for a solar concentrator
[DE92-000604] N92-14483

MEMORY
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695

MEMORY (COMPUTERS)
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
Preliminary basic performance analysis of the Cedar multiprocessor memory system
[NASA-CR-189542] N92-14652
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695

MENTAL PERFORMANCE
Theoretical foundations for information representation and constraint specification
[AD-A241842] N92-14899

MERCURY CADMIUM TELLURIDES
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139

MERIDIONAL FLOW
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942

MESOSCALE PHENOMENA
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794

MESOSPHERE
Measurement of the solar UV flux in the stratosphere N92-14504
Measurement of the absolute solar UV irradiance and variability N92-14522
SMM mesospheric ozone measurements N92-14550

METAL BONDING
Surface modification technologies using concentrated solar radiation N92-14463

METAL COATINGS
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189

METAL FATIGUE
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Database on fatigue of welded aluminium components ALUFAT N92-14399
Assessment of the fatigue behaviour of the microalloyed steels 27MnVS6 and 38MnVS5 N92-14400
Multiaxial fatigue under constant and variable amplitude loading N92-14401
Mechanical properties of PM aluminium alloys N92-14402
Influence of porosity on fatigue behaviour of cast aluminium alloys N92-14403
Improvement of fatigue behaviour of sintered steels by surface rolling N92-14404
Low cycle fatigue of cast nickel base turbine rotors N92-14405
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429

METAL FILMS
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907

METAL JOINTS
Static and dynamic strength of joints in ARALL-laminates N92-14423

METAL MATRIX COMPOSITES
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites
[NASA-TM-105233] N92-14120
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122

METAL OXIDE SEMICONDUCTORS
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295

METAL PARTICLES
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488

METAL PLATES
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790

METAL POWDER
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424

METAL SHEETS
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
Static and dynamic strength of joints in ARALL-laminates N92-14423

METAL SURFACES
Muffler for air powered turbine drive
[AD-D015034] N92-14062
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189

METALS
High energy heavy ion irradiation effect on defect structure of metals
[DE91-638281] N92-14146
Fundamentals of metals joining with lasers
[DE92-000789] N92-14156
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157

METEORITES
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942

METEORITIC MICROSTRUCTURES
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942

METEOROLOGICAL INSTRUMENTS
The ER-2 meteorological measurement system N92-14510
Theoretical modelling and meteorological analysis for the AASE mission N92-14542

METEOROLOGICAL PARAMETERS
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259
The ER-2 meteorological measurement system N92-14510
Data analysis and archival N92-14551
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575

METEOROLOGY
Theoretical modelling and meteorological analysis for the AASE mission N92-14542

METHANE
Chemical reactions driven by concentrated solar energy N92-14475
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491

METHOD OF CHARACTERISTICS
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
METHOD OF MOMENTS
Method of moments analysis of scattering by chiral media
[AD-A241848] N92-14257
METHODOLOGY
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
METHYL ALCOHOL
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135
METRIC SPACE
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
MICHELSON INTERFEROMETERS
Fiber optic smart structures N92-13980
MICROCOMPUTERS
Automated baggage threat detection N92-14032
MICROCRACKS
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
MICROELECTRONICS
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
Custom microcircuits N92-14775
MICROGRAVITY APPLICATIONS
Materials processing in space N92-13964
MICROMECHANICS
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
MICROSEISMS
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793
MICROSTRUCTURE
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
High energy heavy ion irradiation effect on defect structure of metals
[DE91-638281] N92-14146
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys
[DE92-000900] N92-14149
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures
[DE92-000903] N92-14150
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Study of mechanical behavior and internal structure of ferritic nanocrystalline material
[DE92-000760] N92-14162
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
MICROWAVE ANTENNAS
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
MICROWAVE ATTENUATION
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259
MICROWAVE EQUIPMENT
Ionizing radiation survey
[AD-A240966] N92-14253
MICROWAVE FREQUENCIES
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
MICROWAVE LANDING SYSTEMS
Electronic systems in transportation
[TP-9983] N92-14009
Guidance angle measurement of an MLS antenna N92-14011
Comprehensive MLS testing for category 1, 2, and 3 operation N92-14013
The effect of error tolerances on MLS array antenna N92-14014
MLS system error model identification and synthesis N92-14015
Factory acceptance test range N92-14016
Design and analysis techniques for MLS safety critical software N92-14017
DME growth elements and their use with MLS N92-14018
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Testing MLS DME/P transponders and interrogators N92-14020
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
MLS testing using built-in test N92-14024
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025
MICROWAVE SCATTERING
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
MICROWAVE SENSORS
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
MICROWAVE SOUNDING
Estimating stratospheric temperature trends using satellite microwave radiances N92-14546
MICROWAVE TRANSMISSION
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259
MICROWAVE TUBES
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
MICROWAVES
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
MIDDLE ATMOSPHERE
Thermal emission spectroscopy of the middle atmosphere N92-14502
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Stratospheric chemistry and transport N92-14536
Climatological stratospheric modeling N92-14543
Analysis of observations of the middle atmosphere from satellites N92-14545
MILITARY HELICOPTERS
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
MILITARY OPERATIONS
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791
MILITARY TECHNOLOGY
Avionics technology beyond 2000 N92-14058
Neural networks for military robots N92-14680
MILLIMETER WAVES
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
MINERALS
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157
MINIATURIZATION
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
Micro-optic lens for data storage N92-14912
MINIMUM DRAG
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999
MINKOWSKI SPACE
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558
Antiparticles
[DE91-636031] N92-14810
Relativistic theory of gravitation based on the constant curvature space
[DE91-636027] N92-14884
Fedorov universal equations in the string and membrane theories
[DE91-628073] N92-14889
MISALIGNMENT
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349
MISSILE CONTROL
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
MISSILE SIMULATORS
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
MISSION PLANNING
Flight Mechanics/Estimation Theory Symposium, 1991
[NASA-CP-3123] N92-14070
DC-8 mission planning N92-14521
Mission and sampling analyses for atmospheric satellite experiments N92-14554
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949
MIXING LAYERS (FLUIDS)
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] N92-14328
MIXTURES
Insensitive high density explosive
[AD-D015026] N92-14183
MOBILE COMMUNICATION SYSTEMS
Mobile telephony through LEO satellites: To OBP or not N92-14206
MODAL RESPONSE
Finite element structural redesign by large admissible perturbations N92-13935
Structural damage identification using mathematical optimization techniques N92-13936
MODEMS
Laboratory measurements of on-board subsystems N92-14216
Programmable digital modem N92-14231
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234
Flexible digital modulation and coding synthesis for satellite communications N92-14235
MODULARITY
Avionics standardization in Europe N92-14050
Termination of term rewriting: From many-sorted to one-sorted
[RUU-CS-91-16] N92-14653
MODULATION
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
A B-ISDN-compatible modem/codec N92-14229
Multi-stage decoding of multi-level modulation codes N92-14233
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
MODULATORS
On-board processing for telecommunications satellites N92-14227
MODULES
Mixed approach towards modular avionics conflicting requirements N92-14051
Appendices B thru F, volume 3
[NASA-CR-184249] N92-14592
Synthesis of visual modules from examples: Learning hyperacuity
[AD-A241159] N92-14683
MOLDING MATERIALS
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167
MOLECULAR ABSORPTION
Atmospheric propagation N92-14781
MOLECULAR BEAM EPITAXY
Synthesis of mismatched heterojunction/substrate interfaces
[AD-A241845] N92-14283
MOLECULAR BEAMS
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342

MOLECULAR COLLISIONS
Laboratory spectroscopy in support of atmospheric measurements N92-14528
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802
MOLECULAR ENERGY LEVELS
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
MOLECULAR GASES
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
MOLECULAR INTERACTIONS
Photchemistry of intermolecular C-H bond activation reactions
[DE91-018967] N92-14130
MOLECULAR SPECTRA
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
Analysis of atmospheric spectra for trace gases N92-14532
MOLECULAR STRUCTURE
Study of improved methods for predicting chemical equilibria
[DE91-018803] N92-14129
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135
First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865
International Conference on Advanced Methods in X Ray and Neutron Structure Analysis of Materials
[DE91-639071] N92-14871
MOLECULAR WEIGHT
Viscometry constants for 1,4 polybutadiene in tetralin at 135C
[AD-A241843] N92-14125
MOLECULES
Photophysics and photochemistry of porphyrin systems N92-14470
MOLYBDENUM COMPOUNDS
Controlled synthesis of polyenes by catalytic methods
[DE91-018804] N92-14113
MOLYBDENUM SULFIDES
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375
MOMENTUM
The stratospheric residual circulation as deduced from satellite data N92-14498
MOMENTUM THEORY
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702
MONEL (TRADEMARK)
Segregation in welded nickel-base alloys
[DE91-624373] N92-14158
MONITORS
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
Monitoring sea level rise
[REPT-90-1] N92-14576
Initial assessments of life support technology evolution and advanced sensor requirements, volume 2, appendix A
[NASA-CR-184248] N92-14591
MONOPROPELLANTS
Propellant-remaining modeling N92-14096
MONOTONE FUNCTIONS
Improved selection in totally monotone arrays
[DE92-000817] N92-14610
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
On the sum of two maximal monotone operators, 2
[REPT-91-31] N92-14766
MONTE CARLO METHOD
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867
Empirical population synthesis: New directions N92-14938
MORPHOLOGY
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Convergence, continuity and iteration in mathematical morphology
[CWI-BS-R9104] N92-14743
MOTION PERCEPTION
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
MOTION SICKNESS
Flight simulation N92-13982
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586
MOTION SICKNESS DRUGS
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586
MOTION SIMULATION
Flight simulation N92-13982
Assimilation of TIR imagery in numerical models as a tool for water management
[BCRS-90-36] N92-14441
MUFFLERS
Muffler for air powered turbine drive
[AD-D015034] N92-14062
MULTICHANNEL COMMUNICATION
Fault-tolerant multichannel demultiplexer subsystems N92-14220
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
MULTIGRID METHODS
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
MULTIPATH TRANSMISSION
Adaptive optical processor
[AD-A241535] N92-14837
MULTIPHASE FLOW
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316
MULTIPHOTON ABSORPTION
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
MULTIPLEXING
Satellite B-ISDN traffic analysis N92-14208
Laboratory measurements of on-board subsystems N92-14216
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
On-board processing for telecommunications satellites N92-14227
MULTIPROCESSING (COMPUTERS)
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
Shock wave codes at Sandia National Laboratories
[DE91-017847] N92-14612
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Preliminary basic performance analysis of the Cedar multiprocessor memory system
[NASA-CR-189542] N92-14652
Network orientation
[RUU-CS-91-8] N92-14667
MULTISENSOR APPLICATIONS
Multisensor data fusion as applied to guidance and control N92-14681
MULTIVARIATE STATISTICAL ANALYSIS
On approximation and interpolation of convex functions
[MEMO-967] N92-14716

N

NACELLES
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
NAP-OF-THE-EARTH NAVIGATION
Image-based ranging and guidance for rotorcraft
[NASA-CR-184829] N92-14036
NASA PROGRAMS
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
National Aeronautics and Space Administration N92-14921
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
National Aeronautics and Space Administration N92-14923
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924
National Aeronautics and Space Administration N92-14925
National Aeronautics and Space Administration N92-14927
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929
NASA Spinoff, 1990
[NASA-NP-138] N92-14930
Spinoff, 1989
[NASA-TM-105112] N92-14931
Spinoff, 1988
[NASA-TM-105111] N92-14932
NASA SPACE PROGRAMS
JPRS report: Science and technology. USSR: Space. Mishin monograph on failure of Soviet manned lunar program
[JPRS-USP-91-006] N92-14068
NASTRAN
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
NATIONAL AEROSPACE PLANE PROGRAM
Rapid near-optimal aerospace plane trajectory generation and guidance
[NASA-CR-189469] N92-14066
NATIONAL AIRSPACE SYSTEM
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270
NATURAL GAS
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
NATURAL LANGUAGE (COMPUTERS)
Dialogue structuring
[REPT-90-89] N92-14644
NAVIER-STOKES EQUATION
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
Eighteenth Symposium on Naval Hydrodynamics
[LC-91-62359] N92-14300
A boundary integral approach in primitive variables for free surface flows N92-14304
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] N92-14328
NAVIGATION
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
Navigation of the TSS-1 mission N92-14076

Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673
Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674

NAVIGATION AIDS
Cosmic background explorer (COBE) navigation with TDRSS one-way return-link Doppler in the post-helium-venting phase N92-14071
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249

NAVIGATORS
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems
[AD-A241160] N92-14384

NEGATIVE IONS
The new BNL polarized negative ion source
[DE92-000134] N92-14799

NEODYMIUM COMPOUNDS
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879

NEPHELOMETERS
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564

NETHERLANDS
Review of aerodynamic design in the Netherlands N92-13929

NETWORK ANALYSIS
Network orientation
[RUU-CS-91-8] N92-14667
Vision systems for guidance and control: A tutorial overview N92-14679

NETWORK CONTROL
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
On-board processing architectures for satellite B-ISDN services N92-14203
Intelligent network management and functional cerebellum synthesis N92-14697

NETWORKS
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949

NEURAL NETS
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934
Space robotics N92-13987
Satellite communications for the next generation telecommunication services and networks N92-14207
Video data compression using artificial neural network differential vector quantization N92-14214
Neural net sensor fusion
[AD-A241765] N92-14336
A neural network architecture for implementation of expert systems for real time monitoring
[NASA-CR-188988] N92-14669
Automated implementation of rule-based expert systems with neural networks for time-critical applications N92-14670
Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673
Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674
Neural network paradigms N92-14675
A neural network design methodology: Considerations and issues for design and project management N92-14676
Processing complexity of two approaches to object detection and recognition N92-14677
Neural networks for target recognition N92-14678
Vision systems for guidance and control: A tutorial overview N92-14679
Neural networks for military robots N92-14680
Multisensor data fusion as applied to guidance and control N92-14681
Advance neural network architectures for guidance and control N92-14682
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
Intelligent network management and functional cerebellum synthesis N92-14697
Applications of neural networks in high energy physics
[DE90-013325] N92-14825

NEURONS
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
Intelligent network management and functional cerebellum synthesis N92-14697

NEUROPHYSIOLOGY
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586
Intelligent network management and functional cerebellum synthesis N92-14697

NEUTRAL BEAMS
Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Current generation by neutral beam injection in a non-circular tokamak
[DE91-636816] N92-14848

NEUTRAL CURRENTS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701

NEUTRAL GASES
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945

NEUTRAL PARTICLES
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821

NEUTRINOS
Production of neutrinos at HERA
[NIKHEF H/91-07] N92-14824

NEUTRON ACTIVATION ANALYSIS
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis
[DE91-624093] N92-14809

NEUTRON DIFFRACTION
International Conference on Advanced Methods in X Ray and Neutron Structure Analysis of Materials
[DE91-639071] N92-14871

NEUTRON FLUX DENSITY
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154

NEUTRON IRRADIATION
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173

NEUTRON SCATTERING
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors
[DE91-636318] N92-14870

NEUTRON SOURCES
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960

NEUTRON STARS
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

NEUTRONS
Determination of energy distribution for photon and neutron microdosimetry
[DE91-640663] N92-14819

NEWTON METHODS
Projected quasi-Newton updates
[MATHS-REPT-A-144] N92-14605

NICKEL ALLOYS
Grain boundary fracture and alloy design of intermetallics
[DE91-018253] N92-14145
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy
[DE92-000734] N92-14155
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168
Low cycle fatigue of cast nickel base turbine rotors N92-14405
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424

NICKEL STEELS
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406

NIMBUS 7 SATELLITE
Analysis of observations of the middle atmosphere from satellites N92-14545
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547

NITRIC ACID
Particle chemistry impactor experiment N92-14517
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538

NITRIC OXIDE
Binding and catalytic reduction of NO by transition metal aluminosilicates
[DE92-001657] N92-14138

NITROGEN
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160

NITROGEN DIOXIDE
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342

NITROGEN OXIDES
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511

NITROUS OXIDES
Molecular design concept for x ray laser research
[DE92-000972] N92-14343

NOISE GENERATORS
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000

NOISE INTENSITY
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
Modeling nonlinear acoustical blast waves outdoors: A research summary
[AD-A241030] N92-14792

NOISE MEASUREMENT
Colored noise effects on batch attitude accuracy estimates N92-14093
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
Electrochemical noise measurement technique for the determination of aluminum alloy pit initiation rates
[AD-D015050] N92-14144
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
Flyover-noise measurement and prediction N92-14786
Sources of noise in magneto-optical readout N92-14908

NOISE POLLUTION
Flyover-noise measurement and prediction N92-14786
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791

NOISE PREDICTION
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779

The application of experimental data to blade wake interaction noise prediction
[NASA-CR-189461] N92-14789
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793

NOISE PREDICTION (AIRCRAFT)
Flyover-noise measurement and prediction N92-14786
Quiet aircraft design and operational characteristics N92-14787
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797

NOISE PROPAGATION
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Theoretical models for duct acoustic propagation and radiation N92-14782
Interior noise N92-14785
Flyover-noise measurement and prediction N92-14786

NOISE REDUCTION
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Design and performance of duct acoustic treatment N92-14783
Jet noise suppression N92-14784
Interior noise N92-14785
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791
Propeller-driven-small airplane noise certification
[LR-650] N92-14798

NOISE SPECTRA
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793

NOISE TOLERANCE
Human response to aircraft noise N92-14780

NONCONSERVATIVE FORCES
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354

NONDESTRUCTIVE TESTS
Development of a calibration method for deepsea magnetic particle testing N92-14196
Testing a force sensor for underwater magnetic particle inspection N92-14197
Optical proximity sensor for underwater manipulator applications N92-14199
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381

NONEQUILIBRIUM FLOW
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] N92-14326

NONLINEAR OPTICS
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135

NONLINEAR PROGRAMMING
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

NONLINEAR SYSTEMS
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
Bandwidth-limited robust nonlinear spacecraft control N92-14100
Rational approximations to fluid properties
[DE90-012531] N92-14297
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps
[NASA-CR-184263] N92-14344
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems
[AD-A241160] N92-14384
Minimality of dynamic input-output decoupling for nonlinear systems
[MEMO-960] N92-14688
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
Relations between (H infinity) optimal control of a nonlinear system and its linearization
[MEMO-970] N92-14690
Further results in the triangular decoupling problem for nonlinear systems
[MEMO-941] N92-14724
Positive solutions of semilinear elliptic systems
[REPT-91-16] N92-14734
Equivalence of nonlinear systems to input-output prime forms
[MEMO-975] N92-14752
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
Dynamical chaos and beam-beam models
[DE91-639002] N92-14831

NONLINEARITY
A numerical research of nonlinear body-wave interactions N92-14302
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
Method and apparatus for synchronization of dynamical physical systems
[AD-D015020] N92-14376

NONTHERMAL RADIATION
A thermal/nonthermal approach to solar flares
[NASA-TM-4323] N92-14956

NORMALIZING (STATISTICS)
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092

NORTH ATLANTIC TREATY ORGANIZATION (NATO)
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Implications of interoperability and standardization for the industrial base N92-14057

NOTCH STRENGTH
A critical view on the use of K(f) in relation to notch size effect N92-14427

NOTCH TESTS
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
A critical view on the use of K(f) in relation to notch size effect N92-14427

NOTCHES
A critical view on the use of K(f) in relation to notch size effect N92-14427
The effect of overloads on life-time N92-14430

NOZZLE DESIGN
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795

NOZZLE FLOW
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] N92-14319
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] N92-14326

NOZZLE GEOMETRY
High-power hydrogen arcjet performance
[NASA-TM-105143] N92-14109

NOZZLE WALLS
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934

NUCLEAR CAPTURE
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis
[DE91-624093] N92-14809

NUCLEAR EMULSIONS
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961

NUCLEAR ENERGY
Isotopes in everyday life
[DE91-642281] N92-14820

NUCLEAR EXPLOSIONS
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557

NUCLEAR FUELS
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107

NUCLEAR FUSION
ITER conceptual design activities
[DE91-626576] N92-14853

NUCLEAR MAGNETIC RESONANCE
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808

NUCLEAR MEDICINE
Isotopes in everyday life
[DE91-642281] N92-14820

NUCLEAR PHYSICS
GAMUT: A computer code for (gamma)-ray energy and intensity analysis
[DE92-000691] N92-14609
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis
[DE91-624093] N92-14809

NUCLEAR PROPULSION
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
Nuclear technologies for Moon and Mars exploration
[DE91-018832] N92-14951

NUCLEAR REACTIONS
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions
[DE92-000825] N92-14814
Phase-space constraints on inclusive energy spectra of heavy ion fragmentation at intermediate energies
[DE91-641867] N92-14835

NUCLEAR REACTOR CONTROL
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107

NUCLEAR REACTORS
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860

NUCLEAR RESEARCH AND TEST REACTORS
ITER diagnostics
[DE91-626549] N92-14851
ITER conceptual design activities
[DE91-626576] N92-14853

NUCLEAR SPIN
The new BNL polarized negative ion source
[DE92-000134] N92-14799
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

NUCLEI (NUCLEAR PHYSICS)
The new BNL polarized negative ion source
[DE92-000134] N92-14799
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector
[DE91-625052] N92-14962

NUCLEON POTENTIAL
Rotating relativistic neutron stars
[DE92-000806] N92-14941

NUCLEONS
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

NUMERICAL CONTROL
Spacecraft dynamics and control N92-13988
CNC water-jet machining and cutting center
[DE92-000661] N92-14187

NUMERICAL DIFFERENTIATION
Derivative generation in piecewise cubic C(1)-interpolation
[MEMO-976] N92-14719

NUMERICAL STABILITY
Comparison of four stable numerical methods for Abel's integral equation N92-13946

NUTATION
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
NUTATION DAMPERS
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088

O

OBJECT PROGRAMS
Joining distributed complex objects: Definition and performance
[MEMO-INF-91-35] N92-14633
Object-Oriented Data Base (OODB) concepts
[MEMO-INF-91-42] N92-14918
OBJECT-ORIENTED PROGRAMMING
Geographic data modelling in TM
[MEMO-INF-91-53] N92-14640
OBSTACLE AVOIDANCE
Neural networks for military robots N92-14680
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
OCEAN BOTTOM
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793
OCEAN CURRENTS
Satellite remote sensing of large scale ocean transients
[AD-A241122] N92-14574
OCEAN SURFACE
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793
OCEANOGRAPHIC PARAMETERS
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794
OCEANOGRAPHY
Measurements with SHIRA in the ERS-1 rehearsal campaign
[BCRS-91-03] N92-14444
Monitoring sea level rise
[REPT-90-1] N92-14576
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794
OFFSHORE PLATFORMS
Dynamics of risers — associated with offshore platforms N92-14200
OILS
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347
Stability of intershaft squeeze film dampers N92-14351
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
Chemical reactions driven by concentrated solar energy N92-14475
OLIVINE
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942
ONBOARD DATA PROCESSING
Implications of interoperability and standardization for the industrial base N92-14057
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
On-board processing architectures for satellite B-ISDN services N92-14203
Mobile telephony through LEO satellites: To OBP or not N92-14206
Satellite B-ISDN traffic analysis N92-14208
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
On-board processing for telecommunications satellites N92-14227
On-board congestion control for satellite packet switching networks N92-14228
Multi-rate demodulator architecture N92-14232
Evaluating the operations capability of Freedom's Data Management System
[NASA-CR-187315] N92-14894
ONBOARD EQUIPMENT
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
OPERATING COSTS
Ultrox operating experiences with UV/oxidation; economics N92-14451
OPERATING SYSTEMS (COMPUTERS)
A hard real-time operating system for airborne scientific experiments N92-14031
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620
OPERATORS (MATHEMATICS)
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702
Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
New examples of continuum graded Lie algebras
[DE91-623480] N92-14709
On the sum of two maximal monotone operators, 2
[REPT-91-31] N92-14766
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
OPTICAL COMMUNICATION
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
OPTICAL COMPUTERS
Adaptive optical processor
[AD-A241535] N92-14837
OPTICAL DATA STORAGE MATERIALS
Research studies on advanced optical module/head designs for optical devices
[NASA-CR-189756] N92-14902
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Micro-optic lens for data storage N92-14912
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
OPTICAL DISKS
A study of mass data storage technology for rocket engine data
[NASA-CR-185272] N92-14110
Laser beam modeling in optical storage systems N92-14911
OPTICAL EQUIPMENT
Modern energy technologies need modern diagnostics: MHD, a case study
[DE92-000634] N92-14862
Research studies on advanced optical module/head designs for optical devices
[NASA-CR-189756] N92-14902
OPTICAL FIBERS
Fiber optic smart structures N92-13980
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
The techniques of optical fibre measurements: An overall description
[DE91-635892] N92-14840
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841
OPTICAL MEASUREMENT
Upper atmosphere research: Reaction rate and optical measurements N92-14525
Laboratory spectroscopy in support of atmospheric measurements N92-14528
The techniques of optical fibre measurements: An overall description
[DE91-635892] N92-14840
Sources of noise in magneto-optical readout N92-14908
OPTICAL MEASURING INSTRUMENTS
Fiber optic smart structures N92-13980
Optical proximity sensor for underwater manipulator applications N92-14199
A 2-D imaging heat-flux gauge
[DE92-000153] N92-14332
OPTICAL MEMORY (DATA STORAGE)
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Measurement of laser spot quality N92-14910
Laser beam modeling in optical storage systems N92-14911
Micro-optic lens for data storage N92-14912
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913
OPTICAL PROPERTIES
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277
The techniques of optical fibre measurements: An overall description
[DE91-635892] N92-14840
OPTICAL PUMPING
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Solar pumping of lasers N92-14465
Blackbody pumped lasers N92-14467
OPTICAL RADAR
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
Airborne aerosol lidar N92-14519
Laboratory spectroscopy in support of atmospheric measurements N92-14528
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth
[DLR-FB-91-07] N92-14571
OPTICAL REFLECTION
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
OPTICAL THICKNESS
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth
[DLR-FB-91-07] N92-14571
OPTICAL TRACKING
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
OPTIMAL CONTROL
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
Optimal interaction of indenter with inhomogeneous plate N92-13964
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
Relations between (H infinity) optimal control of a nonlinear system and its linearization
[MEMO-970] N92-14690
Super-optimization of four-block problems via the equalizer principle
[MEMO-957] N92-14691
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693
OPTIMIZATION
Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3)
[NASA-CR-188125] N92-13928

On a global aerodynamic optimization of a civil transport aircraft N92-13931
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Structural damage identification using mathematical optimization techniques N92-13936
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
Optimization of the heating surface shape in the contact melting problem N92-13947
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
Research on inverse methods and optimization in Italy N92-13956
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
Airfoil optimization with efficient gradient calculations N92-13960
Design optimization of transonic airfoils N92-13961
On designing for quality N92-13963
Analysis of the optimal laminated target made up of discrete set of materials N92-13965
Inverse problems in the design, modeling and testing of engineering systems N92-13966
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
Inverse problems in diffraction N92-13971
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades [NASA-CR-189018] N92-14038
Formal and heuristic system decomposition methods in multidisciplinary synthesis [NASA-CR-4413] N92-14041
Optimization of the calculation margins of landing gears under extreme loads. Rupture static tests. Part 1: Program and test implantation [CEAT-S8-6551-PARTIEL-1-PT-1] N92-14043
Avionics standardization in Europe N92-14050
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
Projected quasi-Newton updates [MATHS-REPT-A-144] N92-14605
Super-optimization of four-block problems via the equalizer principle [MEMO-957] N92-14691
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization [DE91-634069] N92-14704
Quasi-injective reductions [ITLI-CT-91-11] N92-14723
A framework for test selection [MEMO-INF-91-54] N92-14753
Quasi-analogue method for determination thermal contact resistance [DE91-638960] N92-14829
Gross-Neveu model and optimized expansion method [DE91-636082] N92-14886

OPTOELECTRONIC DEVICES
Photonics N92-14773

ORBIT CALCULATION
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth+Moon elliptic restricted three-body problem [AD-A241690] N92-14069
Flight Mechanics/Estimation Theory Symposium, 1991 [NASA-CP-3123] N92-14070
Cosmic background explorer (COBE) navigation with TDRSS one-way return-link Doppler in the post-helium-venting phase N92-14071
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
Study of geopotential error models used in orbit determination error analysis N92-14083
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
Inclination functions: Group theoretical background and a recursive algorithm [REPT-91-2] N92-14115

ORBIT DECAY
Flight Mechanics/Estimation Theory Symposium, 1991 [NASA-CP-3123] N92-14070

ORBIT PERTURBATION
Inclination functions: Group theoretical background and a recursive algorithm [REPT-91-2] N92-14115

ORBITAL MANEUVERS
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

ORBITS
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
On the symbolic calculation of periodic orbits for the logistic map [MEMO-965] N92-14715

ORDNANCE
Pyrofuze aircraft ordnance arming system [AD-D015024] N92-14040

ORGANIC COMPOUNDS
Effect of light intensity on photocatalytic reaction N92-14449
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450

ORGANOMETALLIC COMPOUNDS
Ceramics derived from organo-metallic precursors [AD-A241849] N92-14172

ORTHOGONALITY
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product [REPT-91-35] N92-14737

OSCILLATIONS
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
Nonlinear coherent beam-beam oscillations in the rigid bunch model [DE91-639001] N92-14830

OUTPUT
Equivalence of nonlinear systems to input-output prime forms [MEMO-975] N92-14752

OXIDATION
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy [DE92-000734] N92-14155
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides [DE92-000815] N92-14175
Preoxidation cleaning optimization for crystalline silicon [DE92-000981] N92-14178
Chemical models of advanced oxidation processes N92-14447
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
Photocatalyzed removal of multiple contaminants from water N92-14453

OXIDATION-REDUCTION REACTIONS
Binding and catalytic reduction of NO by transition metal aluminosilicates [DE92-001657] N92-14138
Polymeric electrolytes for ambient temperature lithium batteries [DE92-000711] N92-14289

OXIDES
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides [DE92-000815] N92-14175

OXIDIZERS
Ultrox operating experiences with UV/oxidation; economics N92-14451

OXYGEN
Steady reactive state in an irreversible reaction [DE91-624220] N92-14132
Vanadium and tantalum frequency spectrum deformation by interstitial impurities [DE91-623605] N92-14160

OXYGEN ATOMS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces [NASA-TM-105363] N92-14114

OXYGEN CONSUMPTION
Chemical models of advanced oxidation processes N92-14447

OXYGEN IONS
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors [DE91-636318] N92-14870

OXYGEN 17
Dynamic-angle spinning and double rotation of quadrupolar nuclei [DE92-000837] N92-14808

OZONE
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors [AD-A241850] N92-14284
Chemical models of advanced oxidation processes N92-14447
Ultrox operating experiences with UV/oxidation; economics N92-14451
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Measurement of the solar UV flux in the stratosphere N92-14504
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Ames ER-2 ozone measurements N92-14512
DC-8 mission planning N92-14521
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Fast two-dimensional model N92-14534
Stratospheric chemistry and transport N92-14536
Upper atmosphere dynamics N92-14544
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
SMM mesospheric ozone measurements N92-14550

OZONE DEPLETION
On the theory of polar ozone holes [DE91-635165] N92-14486
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
Particle chemistry impactor experiment N92-14517
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
Balloon-borne measurements of polar stratospheric ozone N92-14524
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Antarctic news clips, 1991 [NSF-91-79] N92-14561

OZONOMETRY
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Balloon-borne measurements of polar stratospheric ozone N92-14524
High resolution spectroscopy to support atmospheric measurements N92-14529
Upper atmosphere dynamics N92-14544

OZONOSPHERE
Infrared measurements of atmospheric constituents N92-14501

P

P WAVES
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557

P-N JUNCTIONS
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278

P-3 AIRCRAFT
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263

PACKET SWITCHING
On-board processing architectures for satellite B-ISDN services N92-14203
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
Satellite B-ISDN traffic analysis N92-14208
COMSAT Laboratories' on-board baseband switch development N92-14225
On-board congestion control for satellite packet switching networks N92-14228

PACKETS (COMMUNICATION)
On-board congestion control for satellite packet switching networks N92-14228

PACKINGS (SEALS)
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367

PADE APPROXIMATION
1/N-expansion in quantum mechanics, part 2
[DE91-635987] N92-14883

PAINTS
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176

PAIR PRODUCTION
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813

PALLADIUM
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904

PALLADIUM ALLOYS
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147

PANEL METHOD (FLUID DYNAMICS)
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999

PANELS
Design and performance of duct acoustic treatment N92-14783

PARABOLIC REFLECTORS
Photocatalysis with large-scale trough collectors N92-14455
Design of the support structure, drive pedestal, and controls for a solar concentrator
[DE92-000604] N92-14483

PARALLEL COMPUTERS
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration
[AD-A241696] N92-14662

PARALLEL PROCESSING (COMPUTERS)
Space robotics N92-13987
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration
[AD-A241696] N92-14662
Dynamic action scheduling in a parallel database system
[MEMO-INF-91-58] N92-14666
A neural network architecture for implementation of expert systems for real time monitoring
[NASA-CR-188988] N92-14669

PARALLEL PROGRAMMING
A fast parallel Earley bottom up recognizer
[REPT-90-88] N92-14643
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory
[AD-A241691] N92-14657
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development
[AD-A241695] N92-14661
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665

PARAMETER IDENTIFICATION
Structural damage identification using mathematical optimization techniques N92-13936
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
Stress intensity factors for structural details of welded components N92-14407
Constructive identification with Poole's default logic
[REPT-90-86] N92-14642

PARAMETERIZATION
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383

PARITY
Fault-tolerant multichannel demultiplexer subsystems N92-14220

PARSING ALGORITHMS
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618
A fast parallel Earley bottom up recognizer
[REPT-90-88] N92-14643

PARTIAL DIFFERENTIAL EQUATIONS
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972

PARTICLE ACCELERATION
To acceleration and focusing theory in RF quadrupoles
[DE91-638997] N92-14827
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850

PARTICLE ACCELERATORS
Production of neutrinos at HERA
[NIKHEF H/91-07] N92-14824

PARTICLE BEAMS
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS)
[DE91-018526] N92-14126
Space-time structure of hadron interaction
[DE91-623947] N92-14817
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
To acceleration and focusing theory in RF quadrupoles
[DE91-638997] N92-14827

PARTICLE COLLISIONS
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801
Termolecular association and laser-assisted electron-(excited) atom collisions
[AD-A241647] N92-14802
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826

PARTICLE FLUX DENSITY
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496

PARTICLE INTERACTIONS
New parametrization of multiplicity distribution in pp and p(-p) inelastic interactions
[DE91-637100] N92-14805
Hydrodynamical analysis of azimuthal two-particle correlations in relativistic heavy-ion collisions
[DE91-637356] N92-14807
Space-time structure of hadron interaction
[DE91-623947] N92-14817
Classical and quantum mechanics of a spinning particle interacting with background fields
[NIKHEF-H/91-06] N92-14823

PARTICLE LADEN JETS
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061

PARTICLE MOTION
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801

PARTICLE PRODUCTION
The new BNL polarized negative ion source
[DE92-000134] N92-14799
Space-time structure of hadron interaction
[DE91-623947] N92-14817
Production of neutrinos at HERA
[NIKHEF H/91-07] N92-14824

PARTICLE SPIN
On the electrodynamics of spinning particles
[NIKHEF-H/90-22] N92-14822
Classical and quantum mechanics of a spinning particle interacting with background fields
[NIKHEF-H/91-06] N92-14823

PARTICLE THEORY
Extended (N=4) supergravity as a result of reduction from 10-dimensional space
[DE91-628071] N92-14559
Fedorov universal equations in the string and membrane theories
[DE91-628073] N92-14889

PARTICLE TRACKS
Analysis of the results of calibrating meteoritic olivine crystals with U-238 nuclei at the Bevalac accelerator
[DE91-628619] N92-14942

PARTICULATES
Studies of stratospheric particulates N92-14540

PARTITIONS (MATHEMATICS)
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619

PASSENGER AIRCRAFT
China aviation journal (selected article)
[AD-A240985] N92-13990

PATTERN RECOGNITION
Radar vision N92-14026
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584
Analysis of objects in binary images
[NASA-CR-4420] N92-14598
Processing complexity of two approaches to object detection and recognition N92-14677
Neural networks for target recognition N92-14678
Vision systems for guidance and control: A tutorial overview N92-14679
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
Acoustic emission
[DE91-642293] N92-14796
Applications of neural networks in high energy physics
[DE90-013325] N92-14825

PAYLOADS
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764

PENALTY FUNCTION
Airfoil optimization with efficient gradient calculations N92-13960

PENETRATION
Optimal interaction of indenter with inhomogeneous plate N92-13964

PERFORATING
Analysis of the optimal laminated target made up of discrete set of materials N92-13965

PERFORMANCE PREDICTION
Nonstationary gasdynamics N92-13985
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
Design and performance of duct acoustic treatment N92-14783

PERFORMANCE TESTS
Guidance angle measurement of an MLS antenna N92-14011
Factory acceptance test range N92-14016
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Testing MLS DME/P transponders and interrogators N92-14020
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
CNC water-jet machining and cutting center
[DE92-000661] N92-14187
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335

PERIOD DOUBLING
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081

PERIODIC VARIATIONS
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937

PERSIAN GULF
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
PERTURBATION
Finite element structural redesign by large admissible perturbations N92-13935
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845
PERTURBATION THEORY
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
Program complex for problems of atomic physics, part 3
[DE91-636263] N92-14812
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
PETRI NETS
Definition of reusable concurrent software components
[REPT-90-066] N92-14606
Approximate performability analysis using generalized stochastic Petri nets
[MEMO-INF-91-40] N92-14755
PHARMACOLOGY
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586
PHASE DIAGRAMS
Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe
[DE91-634422] N92-14940
PHASE SHIFT
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
PHASE SHIFT KEYING
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
A B-ISDN-compatible modem/codec N92-14229
Programmable digital modem N92-14231
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234
Flexible digital modulation and coding synthesis for satellite communications N92-14235
PHASE TRANSFORMATIONS
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157
A novel phase transition in alloys
[DE92-000366] N92-14161
Slip, twinning and transformation in Laves phases
[DE92-000764] N92-14163
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x)
[DE92-000898] N92-14873
PHASED ARRAYS
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378
PHENOLS
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
PHILOSOPHY
History of constructivism in the twentieth century
[ITLI-ML-91-05] N92-14599
PHOSPHAZENE
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169
PHOSPHORS
A 2-D imaging heat-flux gauge
[DE92-000153] N92-14332
PHOTOACOUSTIC MICROSCOPY
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
PHOTOACOUSTIC SPECTROSCOPY
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization
[AD-A240857] N92-14180
PHOTOCATHODES
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
PHOTOCHEMICAL REACTIONS
Photchemistry of intermolecular C-H bond activation reactions
[DE91-018967] N92-14130
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
Solar photocatalyzed process economics N92-14452
Photocatalyzed removal of multiple contaminants from water N92-14453
Photocatalysis with large-scale trough collectors N92-14455
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Solar pumped lasers and their applications N92-14468
Photochemical synthesis N92-14469
Photophysics and photochemistry of porphyrin systems N92-14470
Potential industrial applications of photons N92-14471
Gas Research Institute experience in solar fuel research N92-14473
Chemical reactions driven by concentrated solar energy N92-14475
Status of European research and development in solar chemistry and industrial interest in this technology N92-14479
Proceedings of the 15th DOE Solar Photochemistry Research Conference
[DE91-015008] N92-14482
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Whole air sampler N92-14513
Measurement of the absolute solar UV irradiance and variability N92-14522
Upper atmosphere research: Reaction rate and optical measurements N92-14525
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950
PHOTODECOMPOSITION
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
PHOTODISSOCIATION
Measurement of the absolute solar UV irradiance and variability N92-14522
PHOTOELECTROCHEMICAL DEVICES
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
PHOTOELECTROCHEMISTRY
Proceedings of the 15th DOE Solar Photochemistry Research Conference
[DE91-015008] N92-14482
PHOTOELECTRON SPECTROSCOPY
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
PHOTOELECTRONS
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
PHOTOGRAPHIC RECORDING
Deformation, fracture and explosive properties of reactive materials
[AD-A241123] N92-14181
PHOTOIONIZATION
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
PHOTOLYSIS
Chemical models of advanced oxidation processes N92-14447
Waste treatment N92-14456
Materials processing and synthesis N92-14460
Applications of energetic particles in improving coating adhesion properties N92-14461
PHOTOMULTIPLIER TUBES
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
PHOTON BEAMS
Photon storage cavities
[DE92-000921] N92-14338
PHOTONICS
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
Photonics N92-14773
PHOTONS
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
Solar pumped lasers and their applications N92-14468
Photochemical synthesis N92-14469
Potential industrial applications of photons N92-14471
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960
PHOTOOXIDATION
Water treatment: Advanced photooxidation processes N92-14446
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
Ultrox operating experiences with UV/oxidation; economics N92-14451
PHOTOSYNTHESIS
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
PHOTOVOLTAIC CONVERSION
Photovoltaic fundamentals
[DE91-015001] N92-14484
PHYSICAL PROPERTIES
Optimization of the heating surface shape in the contact melting problem N92-13947
PHYSICS
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-007] N92-14776
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-006] N92-14777
PHYSIOLOGICAL EFFECTS
Flight simulation N92-13982
Human response to aircraft noise N92-14780
PHYSIOLOGICAL RESPONSES
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008
PIEZOELECTRIC CERAMICS
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877
PIEZOELECTRICITY
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
PILOT PERFORMANCE
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597
PILOT TRAINING
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067
PILOTS (PERSONNEL)
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597

PINCH EFFECT
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
PIONS
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions
[DE92-000825] N92-14814
PIPE FLOW
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
PIPES (TUBES)
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
PITTING
Electrochemical noise measurement technique for the determination of aluminum alloy pit initiation rates
[AD-D015050] N92-14144
PLANAR STRUCTURES
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
PLANE WAVES
Inverse problems in diffraction N92-13971
PLANETARY CRUSTS
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
PLANETARY GEOLOGY
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
PLANETARY GRAVITATION
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
PLANETARY IONOSPHERES
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950
PLANETARY MAGNETOSPHERES
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt
[DE91-623793] N92-14952
PLANETARY MANTLES
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
PLANETARY WAVES
Stratospheric dynamics N92-14537
PLASMA ANTENNAS
Radiation from a dipole antenna into an inhomogeneous, comprehensible, and nonlinear space-plasma
[DLR-FB-91-05] N92-14269
PLASMA COMPOSITION
ITER parametric analysis and operational performance
[DE91-640901] N92-14861
PLASMA CONTROL
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
PLASMA CURRENTS
Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Current generation by neutral beam injection in a non-circular tokamak
[DE91-636816] N92-14848
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
PLASMA DENSITY
New non-axisymmetric eigenmodes associated with an edge plasma layer
[DE90-798727] N92-14843
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
ITER parametric analysis and operational performance
[DE91-640901] N92-14861
PLASMA DIAGNOSTICS
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
ITER diagnostics
[DE91-626549] N92-14851
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
PLASMA DIFFUSION
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt
[DE91-623793] N92-14952
PLASMA DRIFT
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858
PLASMA DYNAMICS
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
PLASMA EQUILIBRIUM
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845
PLASMA GENERATORS
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
PLASMA HEATING
A thermal/nonthermal approach to solar flares
[NASA-TM-4323] N92-14956
PLASMA INTERACTIONS
Radiation from a dipole antenna into an inhomogeneous, comprehensible, and nonlinear space-plasma
[DLR-FB-91-05] N92-14269
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
PLASMA JETS
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858
PLASMA LAYERS
New non-axisymmetric eigenmodes associated with an edge plasma layer
[DE90-798727] N92-14843
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849
PLASMAS (PHYSICS)
Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
PLASMASPHERE
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
PLASTIC DEFORMATION
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387
PLATE THEORY
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
PLATES (STRUCTURAL MEMBERS)
Optimal interaction of indenter with inhomogeneous plate N92-13964
Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield
[NASA-TM-105456] N92-14105
Hypervelocity launch capabilities to over 10 km/s
[DE92-000242] N92-14377
PLATES (TECTONICS)
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
PLATINUM
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
Characterization of magneto-optical media N92-14903
PLUGGING
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
PLUGS
High pressure fiber optic connector plug
[AD-D015033] N92-14839
PLUMES
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
PLY ORIENTATION
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
POINT DEFECTS
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872
POINT SOURCES
Radio frequency investigations of the interstellar medium N92-14936
POINTING CONTROL SYSTEMS
Bandwidth-limited robust nonlinear spacecraft control N92-14100
Langley's CSI evolutionary model: Phase O
[NASA-TM-104165] N92-14394
POISSON DENSITY FUNCTIONS
A new device for the synthesis problem of optimal control of admission to an M/M/c queue
[CWI-BS-R9101] N92-14698
A continuous polling system with general service times
[MEMO-971] N92-14750
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751
POLAR METEOROLOGY
Particle chemistry impactor experiment N92-14517
Airborne aerosol lidar N92-14519
Studies of stratospheric particulates N92-14540
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
POLAR REGIONS
On the theory of polar ozone holes
[DE91-635165] N92-14486
Balloon-borne measurements of polar stratospheric ozone N92-14524
POLARIZATION (SPIN ALIGNMENT)
The new BNL polarized negative ion source
[DE92-000134] N92-14799
POLARIZED LIGHT
White light optical fourier transform device
[AD-D015022] N92-14838
POLICIES
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933
POLLUTION CONTROL
SNL initiatives in electronic fluxless soldering
[DE92-000818] N92-14188
The environmentally safe battery
[DE92-001715] N92-14293
POLLUTION MONITORING
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
POLLUTION TRANSPORT
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488

Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547

POLYBUTADIENE
Viscometry constants for 1,4 polybutadiene in tetralin at 135C
[AD-A241843] N92-14125

POLYCRYSTALS
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture
[DE91-638175] N92-14389
Plotter of pole figure using data from x ray diffraction
[DE91-634207] N92-14868

POLYGONS
Efficient hybrid rendering of volume data and polygons
[REPT-91-17] N92-14650

POLYMER CHEMISTRY
Controlled synthesis of polyenes by catalytic methods
[DE91-018804] N92-14113
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169
Photophysics and photochemistry of porphyrin systems N92-14470

POLYMER MATRIX COMPOSITES
Structural mechanics and materials science N92-13989
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118

POLYMERIC FILMS
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169

POLYNOMIALS
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713
On the symbolic calculation of periodic orbits for the logistic map
[MEMO-965] N92-14715
Derivative generation in piecewise cubic C(1)-interpolation
[MEMO-976] N92-14719
Quasi-injective reductions
[ITLI-CT-91-11] N92-14723
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product
[REPT-91-35] N92-14737
Induced circuits in planar graphs
[CWI-BS-R9106] N92-14744

POLYTOPES
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769

POPULATIONS
Empirical population synthesis: New directions N92-14938

POROSITY
Influence of porosity on fatigue behaviour of cast aluminium alloys N92-14403

POROUS MATERIALS
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture
[DE91-638175] N92-14389

PORPHYRINS
Photophysics and photochemistry of porphyrin systems N92-14470

POSITION (LOCATION)
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263
Neural networks for military robots N92-14680
Scaling properties of band random matrices
[DE91-635977] N92-14705

POSITIVE FEEDBACK
A continuous polling system with general service times
[MEMO-971] N92-14750

POSITRONS
Anisotropy of relativistic lepton coherent scattering at axial channeling
[DE91-623659] N92-14874

POTASSIUM HYDROXIDES
Insensitive high density explosive
[AD-D015026] N92-14183

POTENTIAL FLOW
A boundary integral approach in primitive variables for free surface flows N92-14304
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327

POTENTIAL THEORY
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834

POWDER (PARTICLES)
Ceramics derived from organo-metallic precursors
[AD-A241849] N92-14172

POWDER METALLURGY
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167
Mechanical properties of PM aluminium alloys N92-14402
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424

POWER BEAMING
Solar pumped lasers and their applications N92-14468

POWER CONDITIONING
Multi-megawatt inverter/converter technology for space power applications
[NASA-TM-105307] N92-14294

POWER SUPPLY CIRCUITS
Electrical power supply for short term power interruptions
[AD-D014998] N92-14281

PREAMPLIFIERS
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper
[DE92-000599] N92-14287

PRECIPITATION (CHEMISTRY)
Segregation in welded nickel-base alloys
[DE91-624373] N92-14158

PRECIPITATION (METEOROLOGY)
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492

PRECIPITATION PARTICLE MEASUREMENT
Response level of precipitation sensors
[ETN-92-90311] N92-14573

PRECISION GUIDED PROJECTILES
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664

PREDICTION ANALYSIS TECHNIQUES
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Propellant-remaining modeling N92-14096
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
Design and performance of duct acoustic treatment N92-14783
The application of experimental data to blade wake interaction noise prediction
[NASA-CR-189461] N92-14789
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797

PREDICTIONS
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
Study of improved methods for predicting chemical equilibria
[DE91-018803] N92-14129
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
Development of a new design method to predict impact damage tolerance of composite structures N92-14416
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426

PREDICTOR-CORRECTOR METHODS
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] N92-14328

PREFORMS
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059

PREPROCESSING
Satellite B-ISDN traffic analysis N92-14208
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747

PRESSURE BROADENING
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530

PRESSURE CHAMBERS
Pressure chamber for simulation of deep sea conditions N92-14194

PRESSURE DISTRIBUTION
Inverse airfoil design procedure using a multigrid Navier-Stokes method N92-13932
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
An inverse method with regularity condition for transonic airfoil design N92-13969
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
Effect of viscous damping on the response of floating bodies N92-14303
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358

PRESSURE EFFECTS
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291

PRESSURE HEADS
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063

PRESSURE MEASUREMENT
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353

PRESSURE REDUCTION
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959

PRESSURE VESSELS
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154

PRINTED CIRCUITS
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper
[DE92-000599] N92-14287

PRIORITIES
JPRS report: Science and technology. USSR: Space. Mishin monograph on failure of Soviet manned lunar program
[JPRS-USP-91-006] N92-14068
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928

PROBABILITY DISTRIBUTION FUNCTIONS
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751

PROBABILITY THEORY
Some physical applications of nonstandard logical systems
[DE91-628004] N92-14887
PROBLEM SOLVING
Automated problem resolution prototype in automated en route air traffic control N92-14028
On a doubly degenerate equation arising in fresh-salt water flow with pumping
[REPT-91-30] N92-14324
A model of the self-explanation effect
[AD-A241200] N92-14684
Stoermer-Cowell- and related methods for the numerical solution of second order periodic initial value problems for ODE's. 1: Survey of methods
[MEMO-966] N92-14714
A singular nonlinear Volterra integral equation
[MEMO-955] N92-14731
PROCESS CONTROL (INDUSTRY)
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
Automated implementation of rule-based expert systems with neural networks for time-critical applications N92-14670
PROCESSING
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
PROCUREMENT MANAGEMENT
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
PRODUCT DEVELOPMENT
Unified Life Cycle Engineering (ULCE) design system
[AD-A241039] N92-14608
PRODUCTION ENGINEERING
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474
PRODUCTIVITY
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
PROGNOZ SATELLITES
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849
PROGRAM VERIFICATION (COMPUTERS)
Design and analysis techniques for MLS safety critical software N92-14017
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
A hard real-time operating system for airborne scientific experiments N92-14031
A framework for test selection
[MEMO-INF-91-54] N92-14753
PROGRAMMED INSTRUCTION
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619
PROGRAMMING LANGUAGES
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment N92-14054
Mark 4A antenna control system data handling architecture study N92-14247
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal
[RSRE-91014] N92-14624
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635
An exercise in protocol synthesis
[MEMO-INF-91-46] N92-14636
Geographic data modelling in TM
[MEMO-INF-91-53] N92-14640
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
Theoretical foundations for information representation and constraint specification
[AD-A241842] N92-14899
PROGRESS
Recent progress in inverse methods in France N92-13938
PROJECT MANAGEMENT
Solar thermal energy contract list, fiscal year 1990
[DE91-002175] N92-14481
Stratosphere-troposphere exchange project management N92-14515
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
A neural network design methodology: Considerations and issues for design and project management N92-14676
Program/project management initiative: NASA library project management collection
[NASA-TM-105453] N92-14898
PROJECT PLANNING
Avionics technology beyond 2000 N92-14058
Arctic Research of the United States, Volume 5 N92-14562
PROJECT SETI
The Telecommunications and Data Acquisition Report
[NASA-CR-189484] N92-14237
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
PROJECTILES
Optimal interaction of indenter with inhomogeneous plate N92-13964
Material property for designing, analyzing, and fabricating space structures
[NASA-CR-189516] N92-14119
PROPELLANT COMBUSTION
Nonstationary gasdynamics N92-13985
PROPELLANT GRAINS
Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182
PROPELLANTS
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization
[AD-A240857] N92-14180
PROPELLER BLADES
Study of a new airfoil used in reversible axial fans N92-13970
PROPELLER DRIVE
Propeller-driven-small airplane noise certification
[LR-650] N92-14798
PROPELLERS
Aerodynamics N92-13977
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
PROPULSION
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975
Combustion and propulsion N92-13978
PROPULSION SYSTEM CONFIGURATIONS
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study
[NASA-CR-184204] N92-14106
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
PROPULSION SYSTEM PERFORMANCE
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
PROPULSIVE EFFICIENCY
Technology needs for high speed rotorcraft (3)
[NASA-CR-177592] N92-14039
PROTECTION
Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE-1] N92-14007
PROTECTIVE CLOTHING
International aviation (selected article)
[AD-A240987] N92-13992
PROTECTIVE COATINGS
Materials behaviour in the deep sea environments N92-14195
PROTOCOL (COMPUTERS)
Satellite communications for the next generation telecommunication services and networks N92-14207
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635
An exercise in protocol synthesis
[MEMO-INF-91-46] N92-14636
Standard formatted data units-control authority procedures
[NASA-CR-188127] N92-14897
PROTON BEAMS
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
PROTON IRRADIATION
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
PROTONS
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496
New parametrization of multiplicity distribution in pp and p(-p) inelastic interactions
[DE91-637100] N92-14805
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector
[DE91-625052] N92-14962
PROTOTYPES
COMSAT Laboratories' on-board baseband switch development N92-14225
PROVING
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
PSYCHOPHYSICS
The matching of doubly ambiguous stereograms
[AD-A241251] N92-14587
PSYCHOPHYSIOLOGY
Synthesis of visual modules from examples: Learning hyperacuity
[AD-A241159] N92-14683
PULMONARY CIRCULATION
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584
PULMONARY FUNCTIONS
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584
PULSARS
Rotating relativistic neutron stars
[DE92-000806] N92-14941
PULSE DURATION MODULATION
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
PULSE GENERATORS
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper
[DE92-000599] N92-14287
PULSE MODULATION
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
PULSED LASERS
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
Pulsed laser processing of solar cells N92-14462
PUMP SEALS
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
PYROLYSIS
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476

Q

QUADRATIC EQUATIONS
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
Separatrix cycles and multiple limit cycles in a class of quadratic systems
[REPT-90-84] N92-14732
On defining classes of quadratic systems in the plane
[REPT-91-32] N92-14735
QUADRATURE AMPLITUDE MODULATION
Programmable digital modem N92-14231
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234

Flexible digital modulation and coding synthesis for satellite communications N92-14235
QUADRATURE PHASE SHIFT KEYING
Multi-rate demodulator architecture N92-14232
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234
Flexible digital modulation and coding synthesis for satellite communications N92-14235
QUADRATURES
Generalizing multiquadratic interpolation: Univariate case
[MEMO-974] N92-14718
QUADRUPOLES
Magnetic field in the end region of the SSC quadrupole magnet
[DE92-000850] N92-14778
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808
QUALIFICATIONS
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590
QUALITATIVE ANALYSIS
Optimal interaction of indenter with inhomogeneous plate N92-13964
Capital investment in semiconductors: The lifeblood of the US semiconductor industry
[PB91-165902] N92-14272
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe
[DE91-634422] N92-14940
QUALITY
Measurement of laser spot quality N92-14910
QUALITY CONTROL
On designing for quality N92-13963
Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] N92-14042
Justification for reporting negative value counting results as an alternative to minimum detectable activity
[DE91-018165] N92-14803
QUANTITATIVE ANALYSIS
Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry
[DE91-018610] N92-14127
Object-oriented data handling system for an automated chemistry laboratory
[DE92-000185] N92-14901
QUANTUM CHROMODYNAMICS
New examples of continuum graded Lie algebras
[DE91-623480] N92-14709
On the electrodynamics of spinning particles
[NIKHEF-H/90-22] N92-14822
QUANTUM EFFICIENCY
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
QUANTUM ELECTRODYNAMICS
On topological symmetries and the Goldstone Theorem
[DE91-634058] N92-14880
QUANTUM ELECTRONICS
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277
QUANTUM MECHANICS
Extended (N=4) supergravity as a result of reduction from 10-dimensional space
[DE91-628071] N92-14559
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702
Some physical applications of nonstandard logical systems
[DE91-628005] N92-14707
Classical and quantum mechanics of a spinning particle interacting with background fields
[NIKHEF-H/91-06] N92-14823
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
1/N-expansion in quantum mechanics, part 2
[DE91-635987] N92-14883
Some physical applications of nonstandard logical systems
[DE91-628004] N92-14887
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
Another treatment of the relation between classical and quantum mechanics
[DE91-641534] N92-14891
QUANTUM NUMBERS
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
QUANTUM STATISTICS
Scaling properties of band random matrices
[DE91-635977] N92-14705
QUANTUM THEORY
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886
Phase space structure in gauge theories
[DE91-623483] N92-14890
Another treatment of the relation between classical and quantum mechanics
[DE91-641534] N92-14891
QUARK MODELS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
QUARKS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
Quarks in the instanton vacuum. 1: Quark propagator
[DE91-637129] N92-14806
Space-time structure of hadron interaction
[DE91-623947] N92-14817
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947
QUASARS
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939
QUATERNIONS
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
QUEUEING THEORY
Algorithms for the correct implementation of scheduling policies in distributed systems
[REPT-90-91] N92-14646
A new device for the synthesis problem of optimal control of admission to an M/M/c queue
[CWI-BS-R9101] N92-14698
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751

R

RADAR
Avionics modernization/upgrades in the late 1990s N92-14055
RADAR DETECTION
Measurements with SHIRA in the ERS-1 rehearsal campaign
[BCRS-91-03] N92-14444
RADAR IMAGERY
Radar vision N92-14026
Investigations of freshwater and ice surveying using short-pulse radar
[AD-A241435] N92-14440
RADAR MEASUREMENT
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Laboratory spectroscopy in support of atmospheric measurements N92-14528
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
RADAR TRACKING
Cosmic background explorer (COBE) navigation with TDRSS one-way return-link Doppler in the post-helium-venting phase N92-14071
Neural net sensor fusion
[AD-A241765] N92-14336
RADAR TRANSMISSION
Adaptive optical processor
[AD-A241535] N92-14837
RADIAL FLOW
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943
RADIANT FLUX DENSITY
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960
RADIANT HEATING
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
RADIATION ABSORPTION
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959
RADIATION BELTS
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt
[DE91-623793] N92-14952
RADIATION COUNTERS
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497
Justification for reporting negative value counting results as an alternative to minimum detectable activity
[DE91-018165] N92-14803
RADIATION DETECTORS
Z(sup 0) yields hadrons in SDC
[DE92-000294] N92-14800
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961
RADIATION DISTRIBUTION
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
RADIATION DOSAGE
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results
[RAE-TM-SPACE-383-PT-1] N92-14099
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841
RADIATION EFFECTS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces
[NASA-TM-105363] N92-14114
High energy heavy ion irradiation effect on defect structure of metals
[DE91-638281] N92-14146
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
Irradiation of Bi-based superconducting ceramics with 650 MeV protons
[DE91-628387] N92-14177
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
Support of the NATO Effects Task Group by Los Alamos National Laboratory
[DE92-000251] N92-14841
RADIATION LAWS
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
RADIATION MEASUREMENT
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493
Measurement of the absolute solar UV irradiance and variability N92-14522
GAMUT: A computer code for (gamma)-ray energy and intensity analysis
[DE92-000691] N92-14609
RADIATION SHIELDING
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results
[RAE-TM-SPACE-383-PT-1] N92-14099

RADIATION TRANSPORT
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960
RADIATIVE TRANSFER
Radiative flux measurements in the stratosphere N92-14514
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
RADIO ASTRONOMY
The Telecommunications and Data Acquisition Report
[NASA-CR-189484] N92-14237
RADIO COMMUNICATION
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953
RADIO FREQUENCIES
Transfer impedance of coaxial cables
[DE91-018411] N92-14273
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
Radio frequency investigations of the interstellar medium N92-14936
RADIO NAVIGATION
The Telecommunications and Data Acquisition Report
[NASA-CR-189484] N92-14237
RADIO WAVES
Ground wave propagation of a video pulse source, part 2
[DE92-001794] N92-14264
RADIOACTIVE WASTES
Waste treatment N92-14456
RADIOACTIVITY
Justification for reporting negative value counting results as an alternative to minimum detectable activity
[DE91-018165] N92-14803
RADIOLOGY
Pattern recognition in pulmonary computerized tomography images using Markovian modeling
[TELECOM-PARIS-91-C-002] N92-14584
RAIL TRANSPORTATION
Electronic systems in transportation
[TP-9983] N92-14009
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381
RAIN
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Response level of precipitation sensors
[ETN-92-90311] N92-14573
RAMJET ENGINES
Ceramic regenerator program
[NASA-CR-189053] N92-14374
RANDOM ACCESS MEMORY
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
RANDOM PROCESSES
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
A randomized algorithm for two-process wait-free test-and-set
[ITLI-CT-91-10] N92-14623
Scaling properties of band random matrices
[DE91-635977] N92-14705
A continuous polling system with general service times
[MEMO-971] N92-14750
Combinatorial properties of finite sequences with high Kolomogorov complexity
[ITLI-CT-91-09] N92-14754
Random additive functionals with rapid Markov switchings
[CWI-AM-R9104] N92-14760
RANDOM VIBRATION
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335
RANDOM WALK
Zero drift random walk on N by N with reflection, ergodicity conditions
[CWI-BS-R9114] N92-14770
RANGE AND RANGE RATE TRACKING
Ranging standard. Volume 1: Direct ground to spacecraft ranging
[ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
RANGEFINDING
Image-based ranging and guidance for rotorcraft
[NASA-CR-184829] N92-14036
RARE EARTH ALLOYS
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907
RARE EARTH COMPOUNDS
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879
RARE EARTH ELEMENTS
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
RATES (PER TIME)
Effect of light intensity on photocatalytic reaction N92-14449
RAY TRACING
Efficient hybrid rendering of volume data and polygons
[REPT-91-17] N92-14650
RAYLEIGH SCATTERING
The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564
RDX
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
REACTION KINETICS
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
Effect of light intensity on photocatalytic reaction N92-14449
Waste treatment N92-14456
Upper atmosphere research: Reaction rate and optical measurements N92-14525
REACTION PRODUCTS
Solubility of calcium in CaO-CaCl2
[AWE-0-16/90] N92-14140
REACTIVITY
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
REACTOR DESIGN
Thermochemical energy storage for a lunar base
[NASA-TM-105333] N92-14485
Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844
ITER conceptual design activities
[DE91-626576] N92-14853
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
ITER parametric analysis and operational performance
[DE91-640901] N92-14861
REACTOR MATERIALS
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
REACTOR STARTUP TESTS
ITER parametric analysis and operational performance
[DE91-640901] N92-14861
REACTOR TECHNOLOGY
Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
ITER parametric analysis and operational performance
[DE91-640901] N92-14861
READOUT
Sources of noise in magneto-optical readout N92-14908
REAL NUMBERS
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713
REAL TIME OPERATION
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934
Image-based ranging and guidance for rotorcraft
[NASA-CR-184829] N92-14036
Rapid near-optimal aerospace plane trajectory generation and guidance
[NASA-CR-189469] N92-14066
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Video data compression using artificial neural network differential vector quantization N92-14214
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282
Theoretical modelling and meteorological analysis for the AASE mission N92-14542
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665
A neural network architecture for implementation of expert systems for real time monitoring
[NASA-CR-188988] N92-14669
Neural networks for target recognition N92-14678
REATTACHED FLOW
An experimental investigation of the separating/reattaching flow over a backstep
[NASA-CR-189495] N92-14314
RECEIVERS
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
A receiver design for the superconducting cavity-maser oscillator N92-14238
Suppressed carrier full-spectrum combining N92-14239
A minimalist approach to receiver architecture N92-14241
Streak camera receiver definition study
[NASA-CR-189251] N92-14330
RECOIL ATOMS
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816
RECONNAISSANCE AIRCRAFT
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment N92-14054
RECONSTRUCTION
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713
RECTANGULAR PLATES
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
RECURSIVE FUNCTIONS
Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
REDUCED GRAVITY
Materials processing in space N92-13984
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
Accessing space: A catalogue of process, equipment and resources for commercial users, 1990
[NASA-NP-133] N92-14963
REDUCTION (CHEMISTRY)
Solubility of calcium in CaO-CaCl2
[AWE-0-16/90] N92-14140
REDUNDANCY
Secure refinement
[RSRE-91019] N92-14626
REFLECTANCE
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904

Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959

REFLECTION
Zero drift random walk on N by N with reflection, ergodicity conditions
[CWI-BS-R9114] N92-14770

REFRACTION
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082

REFRACTIVITY
Limitations in transmitter-receiver distances for terrestrial microwave transmissions
[DE91-635167] N92-14259

REFRACTORY MATERIALS
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171

REGENERATION (ENGINEERING)
A continuous polling system with general service times
[MEMO-971] N92-14750

REGENERATORS
Ceramic regenerator program
[NASA-CR-189053] N92-14374

REGOLITH
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480

REGRESSION ANALYSIS
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
A comparison of some quick algorithms for robust regression
[REPT-90-92] N92-14647
Scale sensitivity and rank preservation in a multiplicative variant of the analytic hierarchy process
[REPT-91-20] N92-14758

REGULARITY
An inverse method with regularity condition for transonic airfoil design N92-13969

REGULATIONS
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025
Codex general standard for irradiated foods and recommended international code of practice for the operation of radiation facilities used for the treatment of foods
[DE91-632213] N92-14596

REINFORCING FIBERS
The deformation modes of continuous fibre reinforcements in thermoplastic composites during thermoforming: A preliminary hierarchy and geometrical description
[LR-654] N92-14123

RELATIVISTIC ELECTRON BEAMS
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856

RELATIVISTIC PARTICLES
Hydrodynamical analysis of azimuthal two-particle correlations in relativistic heavy-ion collisions
[DE91-637356] N92-14807

RELATIVISTIC THEORY
Antiparticles
[DE91-636031] N92-14810
Anisotropic space-time
[DE91-636032] N92-14811
Relativistic theory of gravitation based on the constant curvature space
[DE91-636027] N92-14884
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946

RELATIVISTIC VELOCITY
Anisotropic space-time
[DE91-636032] N92-14811

RELATIVITY
Basic procedure of measuring the relativistic length and its modifications
[DE91-628072] N92-14260
Extended (N=4) supergravity as a result of reduction from 10-dimensional space
[DE91-628071] N92-14559
Rotating relativistic neutron stars
[DE92-000806] N92-14941

RELAY SATELLITES
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249

RELIABILITY
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254

RELIABILITY ENGINEERING
Design and analysis techniques for MLS safety critical software N92-14017

REMODULATION
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223

REMOTE CONTROL
Testing a force sensor for underwater magnetic particle inspection N92-14197
Tool exchanger for underwater use N92-14198

REMOTE MANIPULATOR SYSTEM
Space robotics N92-13987

REMOTE SENSING
Radar vision N92-14026
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443
Need for expanded environmental measurement capabilities in geosynchronous Earth orbit
[NASA-CR-183487] N92-14490
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Laboratory spectroscopy in support of atmospheric measurements N92-14528
Solid state devices N92-14772
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data
[DLR-FB-91-06] N92-14959
Accessing space: A catalogue of process, equipment and resources for commercial users, 1990
[NASA-NP-133] N92-14963

REMOTE SENSORS
Satellite remote sensing of large scale ocean transients
[AD-A241122] N92-14574
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943

REMOTELY PILOTED VEHICLES
Underwater Technology Symposium
[VTT-120] N92-14190
Motion dynamics of submersibles N92-14191
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
Tool exchanger for underwater use N92-14198
Optical proximity sensor for underwater manipulator applications N92-14199

REPEATERS
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223

REPORTS
The 1990 Johnson Space Center bibliography of scientific and technical papers
[NASA-TM-104746] N92-14965

REQUIREMENTS
Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE-1] N92-14007
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
Software product assurance requirements for ESA space systems
[ESA-PSS-01-21-ISSUE-2] N92-14631

RESEARCH AND DEVELOPMENT
Shock waves, implosions and dusty gases N92-13986
TDC: Innovation in transport N92-14010
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
JPRS report: Science and technology. USSR: Space
[JPRS-USP-91-007] N92-14101
JPRS report: Science and technology. USSR: Materials science
[JPRS-UMS-91-008] N92-14143
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-91-006] N92-14439
Status of European research and development in solar chemistry and industrial interest in this technology N92-14479
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-019] N92-14577
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-020] N92-14578
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-022] N92-14580
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-023] N92-14581
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-024] N92-14582
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-007] N92-14776
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-006] N92-14777
Publications of the National Institute of Standards and Technology, 1990 catalog
[PB91-216531] N92-14895
National Aeronautics and Space Administration N92-14925
International Science and Technology Insight, Volume 3, Number 1
[NSF-91-14] N92-14934
Annual Research Summary, 1 July 1990 to 30 June 1991 N92-14964

RESEARCH FACILITIES
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487

RESEARCH MANAGEMENT
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493

RESEARCH PROJECTS
Review of aerodynamic design in the Netherlands N92-13929
Solar thermal energy contract list, fiscal year 1990
[DE91-002175] N92-14481
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Arctic Research of the United States, Volume 5 N92-14562

RESEARCH VEHICLES
Numerical investigations in three-dimensional internal flows
[NASA-CR-189467] N92-14313

RESERVOIRS
Photocatalysis with large-scale trough collectors N92-14455

RESIDUAL STRENGTH
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045

RESIDUAL STRESS
Delamination onset in polymeric composite laminates under thermal and mechanical loads
[NASA-CR-189548] N92-14432

RESILIENCE
Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] N92-14042

RESONANCE
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349

RESONANT FREQUENCIES
Finite element structural redesign by large admissible perturbations N92-13935
Structural damage identification using mathematical optimization techniques N92-13936

REVERSE FIELD PINCH
Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844

REVERSING
Study of a new airfoil used in reversible axial fans N92-13970
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858

REYNOLDS NUMBER
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337

REYNOLDS STRESS
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298
Turbulence measurements in a submerged jet near a free surface N92-14305
Modelling of turbulent heat transport: A state-of-the-art [VKI-TM-47] N92-14329
RICCATI EQUATION
Riccati and soliton equations [CWI-AM-R9103] N92-14742
RIEMANN MANIFOLD
Energy-momentum tensor of the gravitational field for material spheres [DE91-628070] N92-14558
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization [DE91-634069] N92-14704
The algebra of Killing vectors in five-dimensional space [DE91-635976] N92-14765
Relativistic theory of gravitation based on the constant curvature space [DE91-636027] N92-14884
RING WINGS
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
RISERS
Underwater Technology Symposium [VTT-120] N92-14190
Dynamics of risers --- associated with offshore platforms N92-14200
RIVETED JOINTS
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420
ROBOT ARMS
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances [MEMO-973] N92-14379
ROBOT CONTROL
Neural networks for military robots N92-14680
Converting a commercial electric direct-drive robot to operate from joint torque commands [DE92-000611] N92-14687
Adaptive PD+ control of rigid robot manipulators [MEMO-958] N92-14692
ROBOTICS
Space robotics N92-13987
Intelligent Robotic Systems Study (IRSS), phase 3 [NASA-CR-184261] N92-14671
Intelligent Robotic Systems Study (IRSS), phase 4 [NASA-CR-184262] N92-14672
Neural networks for military robots N92-14680
ROBOTS
Neural networks for military robots N92-14680
Adaptive PD+ control of rigid robot manipulators [MEMO-958] N92-14692
ROBUSTNESS (MATHEMATICS)
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
Bandwidth-limited robust nonlinear spacecraft control N92-14100
A comparison of some quick algorithms for robust regression [REPT-90-92] N92-14647
Finite-dimensional robust controller designs for distributed parameter systems: A survey [W-9104] N92-14699
ROCKET ENGINES
A study of mass data storage technology for rocket engine data [NASA-CR-185272] N92-14110
Inhibitor and barrier for use with high energy rocket propellants [AD-D015023] N92-14182
ROCKET EXHAUST
Combustion and propulsion N92-13978
ROCKET NOZZLES
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline [NASA-CR-189510] N92-14134
ROCKET SOUNDING
Rocket temperature soundings N92-14523
ROLLING CONTACT LOADS
Improvement of fatigue behaviour of sintered steels by surface rolling N92-14404
ROTARY STABILITY
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps [NASA-CR-184263] N92-14344
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373
ROTARY WING AIRCRAFT
Image-based ranging and guidance for rotorcraft [NASA-CR-184829] N92-14036
Technology needs for high speed rotorcraft (3) [NASA-CR-177592] N92-14039
ROTARY WINGS
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades [NASA-CR-189018] N92-14038
ROTATING SHAFTS
Stability of intershaft squeeze film dampers N92-14351
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354
Hydraulic actuator system for rotor control N92-14363
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371
ROTATION
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
Turbine engine diagnostics system study [DOT/FAA/CT-91/16] N92-14064
Dynamic-angle spinning and double rotation of quadrupolar nuclei [DE92-000837] N92-14808
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
ROTOR AERODYNAMICS
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
ROTOR BLADES (TURBOMACHINERY)
Recent progress in inverse methods in France N92-13938
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
Rub induced rotor/stator vibration analysis on CF700 engine [NRC-TR-ENG-007] N92-14060
Low cycle fatigue of cast nickel base turbine rotors N92-14405
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406
ROTOR DYNAMICS
Limit cycle vibrations in turbomachinery [NASA-TP-3181] N92-14108
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps [NASA-CR-184263] N92-14344
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 [NASA-CP-3122] N92-14346
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371
ROTORCRAFT AIRCRAFT
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
ROTORS
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades [NASA-CR-189018] N92-14038
Limit cycle vibrations in turbomachinery [NASA-TP-3181] N92-14108
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
Hydraulic actuator system for rotor control N92-14363
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
ROUGHNESS
The puzzles of surface science and recent attempts to explain them [DE92-000928] N92-14136
RUBY LASERS
The second front range lidar, aircraft, and balloon experiment [PB91-205567] N92-14564
RULES
Constructive identification with Poole's default logic [REPT-90-86] N92-14642
RUN TIME (COMPUTERS)
Practical computational complexity [RSRE-MEMO-4468] N92-14628
Evaluating the operations capability of Freedom's Data Management System [NASA-CR-187315] N92-14894
RUNWAYS
Electronic systems in transportation [TP-9983] N92-14009

S

SADDLE POINTS
Separatrix cycles and multiple limit cycles in a class of quadratic systems [REPT-90-84] N92-14732
SAFETY FACTORS
Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990 [PB91-910405] N92-14006
Design and analysis techniques for MLS safety critical software N92-14017
Pyrofuze aircraft ordnance arming system [AD-D015024] N92-14040
SAMPLING
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames [AD-A241640] N92-14133
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance [DE91-018467] N92-14488
SANDS
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils [NASA-TM-105234] N92-14179

SAS-3
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937
SATELLITE ATTITUDE CONTROL
Propellant-remaining modeling N92-14096
SATELLITE COMMUNICATION
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205
Satellite communications for the next generation telecommunication services and networks N92-14207
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
A reconfigurable multicarrier demodulator architecture N92-14213
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
Multi-rate demodulator architecture N92-14232
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234
Flexible digital modulation and coding synthesis for satellite communications N92-14235
SATELLITE COMMUNICATIONS SHIPS
Measurements with SHIRA in the ERS-1 rehearsal campaign
[BCRS-91-03] N92-14444
SATELLITE IMAGERY
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
SATELLITE NETWORKS
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
Mobile telephony through LEO satellites: To OBP or not N92-14206
SATELLITE OBSERVATION
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
Satellite remote sensing of large scale ocean transients
[AD-A241122] N92-14574
SATELLITE ORBITS
Improved accuracies for satellite tracking N92-14086
Propellant-remaining modeling N92-14096
GPS: Satellite orbits and atmospheric effects
[REPT-91-1] N92-14097
SATELLITE TRACKING
Improved accuracies for satellite tracking N92-14086
SATELLITE TRANSMISSION
A reconfigurable multicarrier demodulator architecture N92-14213
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
FIDEX: An expert system for satellite diagnostics N92-14218
SATELLITES
Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
SCALARS
US Navy regional climatic study of the Barents Sea and adjacent waters
[AD-A241115] N92-14566
SCALE EFFECT
Scale sensitivity and rank preservation in a multiplicative variant of the analytic hierarchy process
[REPT-91-20] N92-14758
SCALING LAWS
Scaling properties of band random matrices
[DE91-635977] N92-14705
SCATTERING
Inverse problems in diffraction N92-13971
Atmospheric propagation N92-14781
SCATTERING AMPLITUDE
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834
SCATTERING FUNCTIONS
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
SCHEDULING
Algorithms for the correct implementation of scheduling policies in distributed systems
[REPT-90-91] N92-14646
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665
Dynamic action scheduling in a parallel database system
[MEMO-INF-91-58] N92-14666
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700
SCHROEDINGER EQUATION
Another treatment of the relation between classical and quantum mechanics
[DE91-641534] N92-14891
SCHUMANN-RUNGE BANDS
Measurement of the solar UV flux in the stratosphere N92-14504
SCINTILLATION COUNTERS
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results
[RAE-TM-SPACE-383-PT-1] N92-14099
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector
[DE91-625052] N92-14962
SEA ICE
Antarctic news clips, 1991
[NSF-91-79] N92-14561
SEA LEVEL
Monitoring sea level rise
[REPT-90-1] N92-14576
SEA STATES
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575
SEA SURFACE TEMPERATURE
Climatological stratospheric modeling N92-14543
SEA WATER
Materials behaviour in the deep sea environments N92-14195
SEALS (STOPPERS)
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362
SECONDARY EMISSION
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
SEGMENTS
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
SEISMIC WAVES
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949
SEISMOLOGY
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949
SELECTION
A framework for test selection
[MEMO-INF-91-54] N92-14753
SELECTIVE DISSEMINATION OF INFORMATION
Lies, damned lies, and databases
[RSRE-MEMO-4503] N92-14917
SELF ALIGNMENT
Insulator assisted self-aligned gate junction
[AD-D014995] N92-14279
SELF ORGANIZING SYSTEMS
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
Multisensor data fusion as applied to guidance and control N92-14681
SEMANTICS
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635
Constructive fixpoint semantics for truth maintenance systems
[REPT-90-85] N92-14641
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919
SEMICONDUCTOR DIODES
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
SEMICONDUCTOR LASERS
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864
Laser beam modeling in optical storage systems N92-14911
SEMICONDUCTORS (MATERIALS)
Optimal design of solidification processes N92-13944
Capital investment in semiconductors: The lifeblood of the US semiconductor industry
[PB91-165902] N92-14272
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450
First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872
Defect studies in 3-5 thin film semiconductors
[DE92-000052] N92-14875
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors
[DE92-000893] N92-14876
SEPARATED FLOW
On the mechanism of turbulence suppression in free shear flows under acoustic excitation
[NASA-TM-105360] N92-14003
A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
An experimental investigation of the separating/reattaching flow over a backstep
[NASA-CR-189495] N92-14314
SEQUENCING
Increasing the efficiency of an algorithm for solving the problem M(Y,G)
[MEMO-922] N92-14632
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
SERIES EXPANSION
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759
SERVICE LIFE
Preoxidation cleaning optimization for crystalline silicon
[DE92-000981] N92-14178
SERVOMECHANISMS
Hydraulic actuator system for rotor control N92-14363
Differential spot-size focus servo N92-14909
SET THEORY
Termination of term rewriting: From many-sorted to one-sorted
[RUU-CS-91-18] N92-14653
Minimum basis graphs of weighted matroids
[MEMO-950] N92-14727
Collapsing graph models by preorders
[ITLI-ML-91-04] N92-14740
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
Lindeloef in versus in Lindeloef
[REPT-91-23] N92-14767
The consistency of an extended NaDSet
[ITLI-ML-90-11] N92-14768
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919
SHAFTS (MACHINE ELEMENTS)
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
SHALES
Chemical reactions driven by concentrated solar energy N92-14475

SHAPES
Optimization of the heating surface shape in the contact melting problem N92-13947
SHEAR LAYERS
On the mechanism of turbulence suppression in free shear flows under acoustic excitation
[NASA-TM-105360] N92-14003
SHEAR PROPERTIES
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture
[DE91-638175] N92-14389
SHEAR STRESS
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
SHELL THEORY
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816
SHIELDING
Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield
[NASA-TM-105456] N92-14105
SHIPS
Eighteenth Symposium on Naval Hydrodynamics
[LC-91-62359] N92-14300
SHOCK TUBES
Nonstationary gasdynamics N92-13985
SHOCK WAVES
Shock waves, implosions and dusty gases N92-13986
Shock wave codes at Sandia National Laboratories
[DE91-017847] N92-14612
SHOT NOISE
Sources of noise in magneto-optical readout N92-14908
SHROUDED PROPELLERS
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
SIGNAL ANALYSIS
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
SIGNAL DETECTION
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255
Differential spot-size focus servo N92-14909
SIGNAL DETECTORS
Differential spot-size focus servo N92-14909
SIGNAL ENCODING
Flexible High Speed Codec (FHSC) N92-14230
SIGNAL FADING
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030
SIGNAL PROCESSING
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
A minimalist approach to receiver architecture N92-14241
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
Investigations of freshwater and ice surveying using short-pulse radar
[AD-A241435] N92-14440
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation
[AD-A241697] N92-14663
Custom microcircuits N92-14775
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
SIGNAL RECEPTION
Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
Suppressed carrier full-spectrum combining N92-14239
SIGNAL TO NOISE RATIOS
Suppressed carrier full-spectrum combining N92-14239
Determinate-state convolutional codes N92-14242
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
Two-dimensional adaptive enhancement and detection of linear features in noisy images
[DE92-000982] N92-14613
SIGNATURE ANALYSIS
Rub induced rotor/stator vibration analysis on CF700 engine
[NRC-TR-ENG-007] N92-14060
SILICON
Preoxidation cleaning optimization for crystalline silicon
[DE92-000981] N92-14178
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295
Anisotropy of relativistic lepton coherent scattering at axial channeling
[DE91-623659] N92-14874
SILICON CARBIDES
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
SILICON NITRIDES
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Ceramic regenerator program
[NASA-CR-189053] N92-14374
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
SIMULATION
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
Mission and sampling analyses for atmospheric satellite experiments N92-14554
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846
SINGLE CHANNEL PER CARRIER TRANSMISSION
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
SINGLE CRYSTALS
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168
Anisotropy of relativistic lepton coherent scattering at axial channeling
[DE91-623659] N92-14874
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879
SINGULAR INTEGRAL EQUATIONS
A singular nonlinear Volterra integral equation
[MEMO-955] N92-14731
SINTERING
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
Improvement of fatigue behaviour of sintered steels by surface rolling N92-14404
SITE SELECTION
Scientific Rationale and Requirements for a Global Seismic Network on Mars
[NASA-CR-188806] N92-14949
SKIN (STRUCTURAL MEMBER)
Methodology for assessment of skin repairs on Airbus aircraft N92-14428
SKIN FRICTION
An experimental investigation of the separating/reattaching flow over a backstep
[NASA-CR-189495] N92-14314
SKY RADIATION
COBE ground segment attitude determination N92-14079
SKY SURVEYS (ASTRONOMY)
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
SLIP
Slip, twinning and transformation in Laves phases
[DE92-000764] N92-14163
SLOT ANTENNAS
Development of theoretical models of integrated millimeter wave antennas
[NASA-CR-4417] N92-14261
SOBOLEV SPACE
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product
[REPT-91-35] N92-14737
SODIUM
Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: A molecular dynamics study
[DE91-623616] N92-14131
SOFTWARE ENGINEERING
Design and analysis techniques for MLS safety critical software N92-14017
A hard real-time operating system for airborne scientific experiments N92-14031
Avionics software evolution N92-14052
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment N92-14054
Avionics technology beyond 2000 N92-14058
Architecture for Survivable System Processing (ASSP) N92-14210
An engineering approach to ODP systems design
[MEMO-INF-91-49] N92-14600
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
Software product assurance requirements for ESA space systems
[ESA-PSS-01-21-ISSUE-2] N92-14631
Case study of a national educational software development program: The Netherlands
[REPT-91-15] N92-14648
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development
[AD-A241695] N92-14661
A neural network design methodology: Considerations and issues for design and project management N92-14676
SOFTWARE TOOLS
Automated problem resolution prototype in automated en route air traffic control N92-14028
Mixed approach towards modular avionics conflicting requirements N92-14051
Avionics software evolution N92-14052
Architecture for Survivable System Processing (ASSP) N92-14210
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
Symbolic execution of LOTOS specifications
[MEMO-INF-91-47] N92-14637
Geographic data modelling in TM
[MEMO-INF-91-53] N92-14640
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory
[AD-A241692] N92-14658
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700
SOIL MAPPING
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443
SOIL SCIENCE
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
SOILS
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
Object-oriented data handling system for an automated chemistry laboratory
[DE92-000185] N92-14901

SOLAR ACTIVITY
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
SMM mesospheric ozone measurements N92-14550
SOLAR ACTIVITY EFFECTS
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
The flow of plasma in the solar terrestrial environment [NASA-CR-188812] N92-14955
SOLAR ARRAYS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces [NASA-TM-105363] N92-14114
SOLAR CELLS
Enhancing optical absorption in InP and GaAs utilizing profile etching [NASA-TM-105325] N92-14111
Preoxidation cleaning optimization for crystalline silicon [DE92-000981] N92-14178
Data analysis and interpretation related to space system/environment interactions at LEO altitude [NASA-CR-189524] N92-14186
Pulsed laser processing of solar cells N92-14462
Photovoltaic fundamentals [DE91-015001] N92-14484
SOLAR COLLECTORS
Immobilized catalysts in solar concentrators N92-14454
Solar pumping of lasers N92-14465
Photochemical synthesis N92-14469
Chemical reactions driven by concentrated solar energy N92-14475
Design of the support structure, drive pedestal, and controls for a solar concentrator [DE92-000604] N92-14483
Photovoltaic fundamentals [DE91-015001] N92-14484
SOLAR CORONA
Solar x ray astronomy rocket program [NASA-CR-183494] N92-14935
Determination of the coronal magnetic field from vector magnetograph data [NASA-CR-185477] N92-14957
SOLAR CYCLES
Fast two-dimensional model N92-14534
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
SOLAR DYNAMIC POWER SYSTEMS
Analysis of lunar regolith thermal energy storage [NASA-CR-189073] N92-14480
SOLAR ELECTRONS
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954
SOLAR ENERGY
Potential Applications of Concentrated Solar Energy [NAP-S-416] N92-14445
Solar photocatalyzed process economics N92-14452
Immobilized catalysts in solar concentrators N92-14454
Photocatalysis with large-scale trough collectors N92-14455
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
Solar pumped lasers and their applications N92-14468
Fuel processing and thermochemical/photochemical cycles N92-14472
Gas Research Institute experience in solar fuel research N92-14473
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474
Chemical reactions driven by concentrated solar energy N92-14475
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
Status of European research and development in solar chemistry and industrial interest in this technology N92-14479
Solar thermal energy contract list, fiscal year 1990 [DE91-002175] N92-14481
Thermochemical energy storage for a lunar base [NASA-TM-105333] N92-14485
SOLAR ENERGY CONVERSION
Potential Applications of Concentrated Solar Energy [NAP-S-416] N92-14445
Waste treatment N92-14456
Solar technology applications in chemical waste management N92-14459
Solar pumped lasers: Work in progress at the University of Chicago N92-14466
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477
Status of European research and development in solar chemistry and industrial interest in this technology N92-14479
Solar thermal energy contract list, fiscal year 1990 [DE91-002175] N92-14481
Proceedings of the 15th DOE Solar Photochemistry Research Conference [DE91-015008] N92-14482
Design of the support structure, drive pedestal, and controls for a solar concentrator [DE92-000604] N92-14483
SOLAR FLARES
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956
Determination of the coronal magnetic field from vector magnetograph data [NASA-CR-185477] N92-14957
SOLAR FLUX
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Solar pumped lasers: Work in progress at the University of Chicago N92-14466
Blackbody pumped lasers N92-14467
Measurement of the solar UV flux in the stratosphere N92-14504
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
SOLAR FURNACES
Materials processing and synthesis N92-14460
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464
Chemical reactions driven by concentrated solar energy N92-14475
SOLAR GENERATORS
Thermochemical energy storage for a lunar base [NASA-TM-105333] N92-14485
SOLAR HEATING
Solar technology applications in chemical waste management N92-14459
Materials processing and synthesis N92-14460
Applications of energetic particles in improving coating adhesion properties N92-14461
Surface modification technologies using concentrated solar radiation N92-14463
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464
SOLAR INSTRUMENTS
NASA Marshall Space Flight Center solar observatory report, January - June 1991 [NASA-TM-103555] N92-14958
SOLAR MAGNETIC FIELD
Determination of the coronal magnetic field from vector magnetograph data [NASA-CR-185477] N92-14957
SOLAR MAXIMUM MISSION
SMM mesospheric ozone measurements N92-14550
SOLAR OBSERVATORIES
NASA Marshall Space Flight Center solar observatory report, January - June 1991 [NASA-TM-103555] N92-14958
SOLAR PLANETARY INTERACTIONS
Small solar sail spacecraft for Regatta project N92-14102
SOLAR RADIATION
Water treatment: Advanced photooxidation processes N92-14446
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Surface modification technologies using concentrated solar radiation N92-14463
Blackbody pumped lasers N92-14467
Photochemical synthesis N92-14469
High spectral resolution measurements for the ARM Program [DE92-000765] N92-14493
Measurement of the absolute solar UV irradiance and variability N92-14522
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956
SOLAR SAILS
Small solar sail spacecraft for Regatta project N92-14102
SOLAR SENSORS
High spectral resolution measurements for the ARM Program [DE92-000765] N92-14493
SOLAR SPECTRA
Infrared measurements of atmospheric constituents N92-14501
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956
SOLAR-PUMPED LASERS
Solar pumping of lasers N92-14465
Solar pumped lasers: Work in progress at the University of Chicago N92-14466
Blackbody pumped lasers N92-14467
Solar pumped lasers and their applications N92-14468
SOLDERING
Fundamentals of metals joining with lasers [DE92-000789] N92-14156
SNL initiatives in electronic fluxless soldering [DE92-000818] N92-14188
Pre-tinning and flux considerations on the reliability of solder surface [DE92-000905] N92-14189
SOLDERS
Pre-tinning and flux considerations on the reliability of solder surface [DE92-000905] N92-14189
SOLENOIDS
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid [DE91-636500] N92-14856
SOLID LUBRICANTS
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films [AD-A241077] N92-14375
SOLID PROPELLANT IGNITION
Deformation, fracture and explosive properties of reactive materials [AD-A241123] N92-14181
SOLID PROPELLANT ROCKET ENGINES
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline [NASA-CR-189510] N92-14134
SOLID SOLUTIONS
Vanadium and tantalum frequency spectrum deformation by interstitial impurities [DE91-623605] N92-14160
SOLID STATE DEVICES
Center for Space Microelectronics Technology [NASA-CR-189451] N92-14771
Solid state devices N92-14772
SOLID STATE LASERS
Photonics N92-14773
SOLID WASTES
High-temperature photochemistry induced by concentrated solar radiation N92-14457
SOLIDIFICATION
Optimal design of solidification processes N92-13944
Recent advantages in processing and fabrication of ceramic superconductors [DE91-018548] N92-14291
SOLITARY WAVES
Riccati and soliton equations [CWI-AM-R9103] N92-14742
SOLUBILITY
Solubility of calcium in CaO-CaCl2 [AWE-0-16/90] N92-14140
SOLVENTS
Solvent substitution with non-chlorinated biodegradable solvents [DE91-018708] N92-14176
SONDES
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
SOUND FIELDS
Screech noise source structure of a supersonic rectangular jet [NASA-TM-105384] N92-14000
Theoretical models for duct acoustic propagation and radiation N92-14782
SOUND PRESSURE
Screech noise source structure of a supersonic rectangular jet [NASA-TM-105384] N92-14000
SOUND PROPAGATION
Atmospheric propagation N92-14781
SOUND TRANSMISSION
Modeling nonlinear acoustical blast waves outdoors: A research summary [AD-A241030] N92-14792

SOUND WAVES
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
Generalization of traveltime inversion [REPT-91-13] N92-14733
Atmospheric propagation N92-14781
SOUNDING ROCKETS
Solar x ray astronomy rocket program [NASA-CR-183494] N92-14935
SOUTHERN OSCILLATION
Physical processes responsible for ENSO events [DE91-635166] N92-14569
SPACE BASES
Scientific Rationale and Requirements for a Global Seismic Network on Mars [NASA-CR-188806] N92-14949
Nuclear technologies for Moon and Mars exploration [DE91-018832] N92-14951
SPACE COMMERCIALIZATION
Materials processing in space N92-13984
Accessing space: A catalogue of process, equipment and resources for commercial users, 1990 [NASA-NP-133] N92-14963
SPACE COMMUNICATION
Space Communications Technology Conference: Onboard Processing and Switching [NASA-CP-3132] N92-14202
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
The Telecommunications and Data Acquisition Report [NASA-CR-189484] N92-14237
Overview of Ka-band communications technology requirements for the space exploration initiative [NASA-TM-105308] N92-14953
SPACE DEBRIS
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield [NASA-TM-105456] N92-14105
SPACE EXPLORATION
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning [NASA-TM-105214] N92-14649
Overview of Ka-band communications technology requirements for the space exploration initiative [NASA-TM-105308] N92-14953
SPACE LABORATORIES
Small solar sail spacecraft for Regatta project N92-14102
SPACE MECHANICS
Phase-space constraints on inclusive energy spectra of heavy ion fragmentation at intermediate energies [DE91-641867] N92-14835
SPACE PERCEPTION
The matching of doubly ambiguous stereograms [AD-A241251] N92-14587
SPACE PLASMAS
Data analysis and interpretation related to space system/environment interactions at LEO altitude [NASA-CR-189524] N92-14186
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas [NASA-CR-189019] N92-14846
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956
SPACE PLATFORMS
Langley's CSI evolutionary model: Phase O [NASA-TM-104165] N92-14394
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system [NASA-CR-189247] N92-14700
SPACE POWER REACTORS
PEGASUS: An integrated power and propulsion system for the space exploration initiative [DE92-000145] N92-14107
Testing of advanced ceramic fabric heat pipe for a Stirling engine [DE92-000142] N92-14174
Nuclear technologies for Moon and Mars exploration [DE91-018832] N92-14951
SPACE PROCESSING
Materials processing in space N92-13984
SPACE SHUTTLE MAIN ENGINE
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study [NASA-CR-184204] N92-14106
Limit cycle vibrations in turbomachinery [NASA-TP-3181] N92-14108
A study of mass data storage technology for rocket engine data [NASA-CR-185272] N92-14110
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps [NASA-CR-184263] N92-14344
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391
Composite load spectra for select space propulsion structural components [NASA-CR-189078] N92-14435
SPACE SHUTTLE MISSIONS
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results [RAE-TM-SPACE-383-PT-1] N92-14099
Mission and sampling analyses for atmospheric satellite experiments N92-14554
SPACE SHUTTLE ORBITERS
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087
SPACE SHUTTLES
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
SPACE SIMULATORS
Structural mechanics and materials science N92-13989
SPACE STATION FREEDOM
Initial assessments of life support technology evolution and advanced sensor requirements, volume 2, appendix A [NASA-CR-184248] N92-14591
Appendices B thru F, volume 3 [NASA-CR-184249] N92-14592
Advanced instrumentation: Technology database enhancement, volume 4, appendix G [NASA-CR-184250] N92-14593
Clean room survey and assessment, volume 5, appendix H [NASA-CR-184251] N92-14594
Advanced life support study [NASA-CR-184247] N92-14595
Evaluating the operations capability of Freedom's Data Management System [NASA-CR-187315] N92-14894
NASA's plan to restructure the Space Station Freedom [S-HRG-102-268] N92-14929
SPACE TRANSPORTATION
PEGASUS: An integrated power and propulsion system for the space exploration initiative [DE92-000145] N92-14107
SPACE TRANSPORTATION SYSTEM
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study [NASA-CR-184204] N92-14106
National Aeronautics and Space Administration N92-14923
SPACE-TIME FUNCTIONS
Extended (N=4) supergravity as a result of reduction from 10-dimensional space [DE91-628071] N92-14559
Antiparticles [DE91-636031] N92-14810
Anisotropic space-time [DE91-636032] N92-14811
Space-time structure of hadron interaction [DE91-623947] N92-14817
Relativistic theory of gravitation based on the constant curvature space [DE91-636027] N92-14884
Gross-Neveu model and optimized expansion method [DE91-636082] N92-14886
SPACEBORNE ASTRONOMY
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089
SPACEBORNE EXPERIMENTS
Mission and sampling analyses for atmospheric satellite experiments N92-14554
SPACECRAFT COMMUNICATION
Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
Overview of Ka-band communications technology requirements for the space exploration initiative [NASA-TM-105308] N92-14953
SPACECRAFT CONFIGURATIONS
Appendices B thru F, volume 3 [NASA-CR-184249] N92-14592
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas [NASA-CR-189019] N92-14846
SPACECRAFT CONSTRUCTION MATERIALS
Materials processing in space N92-13984
Structural mechanics and materials science N92-13989
SPACECRAFT CONTROL
Spacecraft dynamics and control N92-13988
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
Bandwidth-limited robust nonlinear spacecraft control N92-14100
SPACECRAFT GUIDANCE
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087
SPACECRAFT ORBITS
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth + Moon elliptic restricted three-body problem [AD-A241690] N92-14069
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
Study of geopotential error models used in orbit determination error analysis N92-14083
SPACECRAFT POWER SUPPLIES
Multi-megawatt inverter/converter technology for space power applications [NASA-TM-105307] N92-14294
Nuclear technologies for Moon and Mars exploration [DE91-018832] N92-14951
SPACECRAFT PROPULSION
Propellant-remaining modeling N92-14096
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study [NASA-CR-184204] N92-14106
Composite load spectra for select space propulsion structural components [NASA-CR-189078] N92-14435
Nuclear technologies for Moon and Mars exploration [DE91-018832] N92-14951
SPACECRAFT REENTRY
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
SPACECRAFT SHIELDING
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
SPACECRAFT STABILITY
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
SPACECRAFT STRUCTURES
Material property for designing, analyzing, and fabricating space structures [NASA-CR-189516] N92-14119
SPACECRAFT TRACKING
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth + Moon elliptic restricted three-body problem [AD-A241690] N92-14069
Cosmic background explorer (COBE) navigation with TDRSS one-way return-link Doppler in the post-helium-venting phase N92-14071
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
Bandwidth-limited robust nonlinear spacecraft control N92-14100
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
Expected antenna utilization and overload N92-14248
Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
SPARE PARTS
On designing for quality N92-13963
SPATIAL RESOLUTION
Processing complexity of two approaches to object detection and recognition N92-14677
Synthesis of visual modules from examples: Learning hyperacuity [AD-A241159] N92-14683

SPECIFIC HEAT
Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: A molecular dynamics study
[DE91-623616] N92-14131

SPECIFICATIONS
On designing for quality N92-13963
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
Specimens for fatigue and fracture evaluation of metals: FRAG recommendations (first issue)
[RAE-TR-91025] N92-14166
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635

SPECIMEN GEOMETRY
Specimens for fatigue and fracture evaluation of metals: FRAG recommendations (first issue)
[RAE-TR-91025] N92-14166

SPECTRA
Suppressed carrier full-spectrum combining N92-14239
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
Measurement of the solar UV flux in the stratosphere N92-14504
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905

SPECTRAL BANDS
Infrared measurements of atmospheric constituents N92-14501

SPECTRAL LINE WIDTH
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869

SPECTRAL REFLECTANCE
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442

SPECTRAL RESOLUTION
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531

SPECTROMETERS
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493
Measurement of the solar UV flux in the stratosphere N92-14504
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Z(sup 0) yields hadrons in SDC
[DE92-000294] N92-14800
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808

SPECTROSCOPIC ANALYSIS
Upper atmosphere research: Reaction rate and optical measurements N92-14525
High resolution spectroscopy to support atmospheric measurements N92-14529
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531

SPECTROSCOPY
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline
[NASA-CR-189510] N92-14134
Thermal emission spectroscopy of the middle atmosphere N92-14502
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Laboratory spectroscopy in support of atmospheric measurements N92-14528
High resolution spectroscopy to support atmospheric measurements N92-14529
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804

SPECTRUM ANALYSIS
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
Analysis of atmospheric spectra for trace gases N92-14532
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

SPEECH
Dialogue structuring
[REPT-90-89] N92-14644

SPHERES
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558

SPHERICAL HARMONICS
Inclination functions: Group theoretical background and a recursive algorithm
[REPT-91-2] N92-14115

SPHERICAL SHELLS
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429

SPHEROIDS
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306

SPIN
Classical theory of a structural point object in the 2nd order approximation
[DE91-628031] N92-14818

SPIN DYNAMICS
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

SPIN STABILIZATION
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088

SPINOR GROUPS
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886

SPIRAL GALAXIES
Empirical population synthesis: New directions N92-14938

SPLINE FUNCTIONS
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
Derivative generation in piecewise cubic C(1)-interpolation
[MEMO-976] N92-14719
On radial spline interpolation
[MEMO-948] N92-14725

SPOT (FRENCH SATELLITE)
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443

SPRAY CHARACTERISTICS
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112

SPRAYERS
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315

SPUTTERING
High temperature static strain gage development
[NASA-CR-189044] N92-14037
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816

SQUEEZE FILMS
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Stability of intershaft squeeze film dampers N92-14351
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353

STABILITY
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620

STAGNATION POINT
The flow configuration of protons and alpha particles in the Earth's subsolar magnetosheath N92-14496

STAINLESS STEELS
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS
[DE91-018827] N92-14395

STANDARDIZATION
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Avionics standardization in the USAF: 1980 to 1990 N92-14048
Historical perspective on the evolution of avionics standards N92-14049
Avionics standardization in Europe N92-14050
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
Implications of interoperability and standardization for the industrial base N92-14057
An engineering approach to ODP systems design
[MEMO-INF-91-49] N92-14600

STANDARDS
Historical perspective on the evolution of avionics standards N92-14049
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
International global network of fiducial stations: Scientific and implementation issues
[NASA-CR-189525] N92-14236
Ranging standard. Volume 1: Direct ground to spacecraft ranging
[ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
Propeller-driven-small airplane noise certification
[LR-650] N92-14798
Publications of the National Institute of Standards and Technology, 1990 catalog
[PB91-216531] N92-14895

STANDING WAVES
Discrete cavity model of a standing-wave free-electron laser
[DE92-000839] N92-14340

STAR FORMATION
Empirical population synthesis: New directions N92-14938

STAR TRACKERS
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090

STATE VECTORS
Navigation of the TSS-1 mission N92-14076
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Advance neural network architectures for guidance and control N92-14682
State space formulas for transfer poles at infinity
[CWI-BS-R9108] N92-14748

STATIC CHARACTERISTICS
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361

STATIC PRESSURE
Adjoint operator approach to shape design for internal incompressible flows N92-13957
Static and dynamic pressure distributions in a short labyrinth seal N92-14355

STATIC TESTS
Methodology for assessment of skin repairs on Airbus aircraft N92-14428

STATISTICAL ANALYSIS
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
Approximate performability analysis using generalized stochastic Petri nets
[MEMO-INF-91-40] N92-14755

STATISTICAL CORRELATION
Colored noise effects on batch attitude accuracy estimates N92-14093
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094

STATISTICAL DISTRIBUTIONS
A comparison of some quick algorithms for robust regression
[REPT-90-92] N92-14647

Equivalence of nonlinear systems to input-output prime forms
[MEMO-975] N92-14752
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761

STATISTICS
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
FAA statistical handbook of aviation: Calendar year 1989
[PB91-202051] N92-13927

STATORS
Rub induced rotor/stator vibration analysis on CF700 engine
[NRC-TR-ENG-007] N92-14060
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367

STEADY STATE
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132

STEAM TURBINES
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406

STEELS
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Assessment of the fatigue behaviour of the microalloyed steels 27MnVS6 and 38MnVS5 N92-14400
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422

STEEPEST DESCENT METHOD
Airfoil optimization with efficient gradient calculations N92-13960

STEERABLE ANTENNAS
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378

STEERING
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378

STELLAR ENVELOPES
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944

STELLAR LUMINOSITY
Empirical population synthesis: New directions N92-14938

STELLAR MAGNETIC FIELDS
Spin ordering in dense matter and magnetic fields of neutron stars
[DE91-641846] N92-14947

STELLAR RADIATION
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

STELLAR ROTATION
Rotating relativistic neutron stars
[DE92-000806] N92-14941

STELLAR SPECTRA
Radio frequency investigations of the interstellar medium N92-14936
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937
Empirical population synthesis: New directions N92-14938
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

STEP FUNCTIONS
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271

STEREOSCOPIC VISION
The matching of doubly ambiguous stereograms
[AD-A241251] N92-14587

STIFFNESS
Structural damage identification using mathematical optimization techniques N92-13936

STIFFNESS MATRIX
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434

STIMULATED EMISSION
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333

STIRLING CYCLE
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174
Design of the support structure, drive pedestal, and controls for a solar concentrator
[DE92-000604] N92-14483

STIRLING ENGINES
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174

STOCHASTIC PROCESSES
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751
Approximate performability analysis using generalized stochastic Petri nets
[MEMO-INF-91-40] N92-14755

STOICHIOMETRY
Self-propagating reactions for synthesis of high temperature materials
[AD-A241660] N92-14171
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867

STORAGE RINGS (PARTICLE ACCELERATORS)
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830
Dynamical chaos and beam-beam models
[DE91-639002] N92-14831

STORAGE TANKS
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323

STORM SURGES
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575

STRAIN DISTRIBUTION
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383

STRAIN ENERGY RELEASE RATE
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
Delamination onset in polymeric composite laminates under thermal and mechanical loads
[NASA-CR-189548] N92-14432

STRAIN GAGES
High temperature static strain gage development
[NASA-CR-189044] N92-14037
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331

STRAIN MEASUREMENT
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433

STRAIN RATE
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387

STRATIFICATION
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323

STRATOSPHERE
On the theory of polar ozone holes
[DE91-635165] N92-14486
The stratospheric residual circulation as deduced from satellite data N92-14498
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Infrared measurements of atmospheric constituents N92-14501
Thermal emission spectroscopy of the middle atmosphere N92-14502
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Measurement of the solar UV flux in the stratosphere N92-14504
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Ames ER-2 ozone measurements N92-14512
Radiative flux measurements in the stratosphere N92-14514
Stratosphere-troposphere exchange project management N92-14515
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
Particle chemistry impactor experiment N92-14517
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
Airborne aerosol lidar N92-14519
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
Measurement of the absolute solar UV irradiance and variability N92-14522
Rocket temperature soundings N92-14523
Balloon-borne measurements of polar stratospheric ozone N92-14524
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Laboratory spectroscopy in support of atmospheric measurements N92-14528
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
Analysis of atmospheric spectra for trace gases N92-14532
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Stratospheric dynamics and transport studies N92-14535
Stratospheric chemistry and transport N92-14536
Stratospheric dynamics N92-14537
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538
Stratospheric Data Analysis System (STRATAN) N92-14539
Studies of stratospheric particulates N92-14540
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
Theoretical modelling and meteorological analysis for the AASE mission N92-14542
Climatological stratospheric modeling N92-14543
Analysis of observations of the middle atmosphere from satellites N92-14545
Estimating stratospheric temperature trends using satellite microwave radiances N92-14546
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
SMM mesospheric ozone measurements N92-14550
Analysis of troposphere-stratosphere exchange N92-14552
Upper Atmosphere Data Program (UADP) N92-14553

STREAK CAMERAS
Streak camera receiver definition study
[NASA-CR-189251] N92-14330

STRESS ANALYSIS
Structural mechanics and materials science N92-13989
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872

STRESS CONCENTRATION
A critical view on the use of K(f) in relation to notch size effect N92-14427
STRESS CORROSION CRACKING
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS
[DE91-018627] N92-14395
STRESS DISTRIBUTION
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872
STRESS INTENSITY FACTORS
Stress intensity factors for structural details of welded components N92-14407
STRESS MEASUREMENT
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
STRESS TENSORS
Turbulence measurements in a submerged jet near a free surface N92-14305
STRESS-STRAIN RELATIONSHIPS
Review of investigations on aeronautical fatigue in the Federal Republic of Germany
[ETN-92-90317] N92-14397
STRESSES
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
STRING THEORY
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
Fedorov universal equations in the string and membrane theories
[DE91-628073] N92-14889
STRINGERS
Fatigue of repaired composite structures N92-14411
STRIP TRANSMISSION LINES
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Method of moments analysis of scattering by chiral media
[AD-A241848] N92-14257
STRUCTURAL ANALYSIS
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385
STRUCTURAL DESIGN
Inverse problems in the design, modeling and testing of engineering systems N92-13966
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929
STRUCTURAL ENGINEERING
Langley's CSI evolutionary model: Phase O
[NASA-TM-104165] N92-14394
STRUCTURAL PROPERTIES (GEOLOGY)
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
STRUCTURAL RELIABILITY
A concept for the revisions of structural inspection schedules N92-14431
STRUCTURAL STABILITY
Dynamics of risers — associated with offshore platforms N92-14200
Stability of intershaft squeeze film dampers N92-14351
STRUCTURAL VIBRATION
Spacecraft dynamics and control N92-13988
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990
[NASA-CP-3122] N92-14346
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
Proceedings of Damping 1991, volume 3
[AD-A241313] N92-14386
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
SUBCONTRACTS
Solar thermal energy contract list, fiscal year 1990
[DE91-002175] N92-14481
SUBDUCTION (GEOLOGY)
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
SUBROUTINES
A fast parallel Earley bottom up recognizer
[REPT-90-88] N92-14643
SUBSONIC FLOW
Research on inverse methods and optimization in Italy N92-13956
SUBSTITUTES
Solvent substitution with non-chlorinated biodegradable solvents
[DE91-018708] N92-14176
SUBSTRATES
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
Defect studies in 3-5 thin film semiconductors
[DE92-000052] N92-14875
SULFIDES
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879
SULFUR
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
SULFUR DIOXIDES
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams
[DE91-013217] N92-14169
SULFUR OXIDES
Regional analysis of S emission-deposition trends in North America from 1979 through 1988
[DE91-018545] N92-14489
SUM RULES
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
SUNLIGHT
Photocatalysis with large-scale trough collectors N92-14455
Blackbody pumped lasers N92-14467
Fuel processing and thermochemical/photochemical cycles N92-14472
SUPERCONDUCTING FILMS
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867
SUPERCONDUCTING MAGNETS
Magnetic field in the end region of the SSC quadrupole magnet
[DE92-000850] N92-14778
SUPERCONDUCTING SUPER COLLIDER
Magnetic field in the end region of the SSC quadrupole magnet
[DE92-000850] N92-14778
SUPERCONDUCTIVITY
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
A receiver design for the superconducting cavity-maser oscillator N92-14238
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
SUPERCONDUCTORS
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle
[NASA-CR-189090] N92-14436
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867
SUPERCRITICAL AIRFOILS
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
SUPERCRITICAL FLOW
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
SUPERGRAVITY
Extended (N=4) supergravity as a result of reduction from 10-dimensional space
[DE91-628071] N92-14559
SUPERHIGH FREQUENCIES
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
SUPERLATTICES
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277
Solid state devices N92-14772
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
SUPERNOVA REMNANTS
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944
SUPERSONIC BOUNDARY LAYERS
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298
SUPERSONIC FLOW
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
SUPERSONIC JET FLOW
Screech noise source structure of a supersonic rectangular jet
[NASA-TM-105384] N92-14000
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797
SUPERSONIC TURBINES
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974
SUPERSYMMETRY
Classical and quantum mechanics of a spinning particle interacting with background fields
[NIKHEF-H/91-06] N92-14823
SURFACE ACOUSTIC WAVE DEVICES
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224
SURFACE DEFECTS
A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167
SURFACE LAYERS
Method of moments analysis of scattering by chiral media
[AD-A241848] N92-14257
SURFACE PROPERTIES
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Optimization of the heating surface shape in the contact melting problem N92-13947
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
The puzzles of surface science and recent attempts to explain them
[DE92-000928] N92-14136
Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] N92-14141
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189
A boundary integral approach in primitive variables for free surface flows N92-14304
SURFACE REACTIONS
Surface modification technologies using concentrated solar radiation N92-14463
SURFACE ROUGHNESS EFFECTS
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267
SURFACE TEMPERATURE
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829
SURFACE TREATMENT
Materials processing and synthesis N92-14460
SURFACE WAVES
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
Vortex ring interaction with a free surface N92-14308

Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793

SURFACES
Vortex ring interaction with a free surface N92-14308

SURVEYS
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
Investigations of freshwater and ice surveying using short-pulse radar
[AD-A241435] N92-14440

SWIRLING
Static and dynamic pressure distributions in a short labyrinth seal N92-14355

SWITCHES
COMSAT Laboratories' on-board baseband switch development N92-14225
Photonics N92-14773
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864

SWITCHING
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
On-board processing architectures for satellite B-ISDN services N92-14203
Mobile telephony through LEO satellites: To OBP or not N92-14206
Fault-tolerant multichannel demultiplexer subsystems N92-14220
On-board demux/demod N92-14221

SWITCHING CIRCUITS
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295

SYMBOLIC PROGRAMMING
Symbolic execution of LOTOS specifications
[MEMO-INF-91-47] N92-14637

SYMMETRY
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product
[REPT-91-35] N92-14737
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749

SYNAPSES
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696

SYNCHRONISM
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
Satellite B-ISDN traffic analysis N92-14208
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
Method and apparatus for synchronization of dynamical physical systems
[AD-D015020] N92-14376
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654

SYNCHRONOUS PLATFORMS
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
Need for expanded environmental measurement capabilities in geosynchronous Earth orbit
[NASA-CR-183487] N92-14490

SYNCHROTRONS
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826

SYNOPTIC MEASUREMENT
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

SYNTAX
On the metamathematics of weak theories
[ITLI-ML-91-02] N92-14738

SYNTHESIS (CHEMISTRY)
Controlled synthesis of polyenes by catalytic methods
[DE91-018804] N92-14113
Ceramics derived from organo-metallic precursors
[AD-A241849] N92-14172
Photochemical synthesis N92-14469
Potential industrial applications of photons N92-14471
Gas Research Institute experience in solar fuel research N92-14473

SYSTEM FAILURES
MLS testing using built-in test N92-14024
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634

SYSTEM IDENTIFICATION
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967

SYSTEMS ANALYSIS
Expected antenna utilization and overload N92-14248
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665

SYSTEMS COMPATIBILITY
A DME transponder system approach for convertibility, monitoring, and diagnostics N92-14022

SYSTEMS ENGINEERING
Inverse problems in the design, modeling and testing of engineering systems N92-13966
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Avionics systems development: Technological trends, conflicts, and cost issues in a changing European environment N92-14054
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
Appendices B thru F, volume 3
[NASA-CR-184249] N92-14592
Advanced life support study
[NASA-CR-184247] N92-14595

SYSTEMS INTEGRATION
Avionics technology beyond 2000 N92-14058
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development
[AD-A241695] N92-14661

SYSTEMS MANAGEMENT
Intelligent network management and functional cerebellum synthesis N92-14697

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TABLES (DATA)
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
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[PB91-202051] N92-13927

TACTICS
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685

TAKEOFF
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008

TANTALUM
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160

TARGET RECOGNITION
Radar vision N92-14026
Neural networks for target recognition N92-14678
Vision systems for guidance and control: A tutorial overview N92-14679

TARGETS
Optimal interaction of indenter with inhomogeneous plate N92-13964
Analysis of the optimal laminated target made up of discrete set of materials N92-13965

TAXONOMY
Neural network paradigms N92-14675

TAYLOR INSTABILITY
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322

TDR SATELLITES
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082

TEACHING MACHINES
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601

TECHNOLOGICAL FORECASTING
International aviation (selected article)
[AD-A240986] N92-13991
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649

TECHNOLOGIES
Publications of the National Institute of Standards and Technology, 1990 catalog
[PB91-216531] N92-14895
International Science and Technology Insight, Volume 3, Number 1
[NSF-91-14] N92-14934

TECHNOLOGY ASSESSMENT
International aviation (selected article)
[AD-A240986] N92-13991
Energy source possibilities in underwater technics N92-14193
Solar technology applications in chemical waste management N92-14459
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953

TECHNOLOGY TRANSFER
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476

TECHNOLOGY UTILIZATION
JPRS report: Science and technology. USSR: Space
[JPRS-USP-91-007] N92-14101
Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] N92-14141
Potential Applications of Concentrated Solar Energy
[NAP-S-416] N92-14445
NASA Spinoff, 1990
[NASA-NP-138] N92-14930
Spinoff, 1989
[NASA-TM-105112] N92-14931
Spinoff, 1988
[NASA-TM-105111] N92-14932
Nuclear technologies for Moon and Mars exploration
[DE91-018832] N92-14951

TECTONICS
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948

TELECOMMUNICATION
On-board processing for telecommunications satellites N92-14227
The Telecommunications and Data Acquisition Report
[NASA-CR-189484] N92-14237
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266

TELEMETRY
Suppressed carrier full-spectrum combining N92-14239
Some partial-unit-memory convolutional codes N92-14243
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246

TELEOPERATORS
Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671

TELEPHONES
Mobile telephony through LEO satellites: To OBP or not N92-14206
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266

TELEPHONY
Mobile telephony through LEO satellites: To OBP or not N92-14206

TELESCOPES
Improved accuracies for satellite tracking N92-14086
NASA Marshall Space Flight Center solar observatory report, January - June 1991
[NASA-TM-103555] N92-14958

TEMPERATE REGIONS
Analysis of troposphere-stratosphere exchange N92-14552
TEMPERATURE DEPENDENCE
Optimization of the heating surface shape in the contact melting problem N92-13947
TEMPERATURE DISTRIBUTION
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
TEMPERATURE EFFECTS
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing [NASA-TM-105313] N92-14118
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites [NASA-TM-105233] N92-14120
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys [DE92-000900] N92-14149
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures [DE92-000903] N92-14150
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152
Study of mechanical behavior and internal structure of ferritic nanocrystalline material [DE92-000760] N92-14162
Recent advantages in processing and fabrication of ceramic superconductors [DE91-018548] N92-14291
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100) [DE92-000868] N92-14872
TEMPERATURE MEASUREMENT
Irradiation of Bi-based superconducting ceramics with 650 MeV protons [DE91-628387] N92-14177
Rocket temperature soundings N92-14523
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Flux-profile relationships in the nocturnal boundary layer [KNMI-TR-130] N92-14570
TENSILE DEFORMATION
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420
TENSILE PROPERTIES
The effects of multiple repairs on Inconel 718 weld mechanical properties [NASA-TM-103559] N92-14380
TENSILE STRENGTH
Static and dynamic strength of joints in ARALL-laminates N92-14423
TENSILE TESTS
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material [DE92-000927] N92-14152
An evaluation of strain measuring devices for ceramic composites [NASA-TM-105337] N92-14433
TENSOR ANALYSIS
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates [REPT-91-12] N92-14321
TENSORS
Energy-momentum tensor of the gravitational field for material spheres [DE91-628070] N92-14558
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators [DE91-635999] N92-14702
The algebra of Killing vectors in five-dimensional space [DE91-635976] N92-14765
TERBIUM
Characterization of magneto-optical media N92-14903
TERMINAL BALLISTICS
Optimal interaction of indenter with inhomogeneous plate N92-13964
Analysis of the optimal laminated target made up of discrete set of materials N92-13965
TERMS
Termination of term rewriting: From many-sorted to one-sorted [RUU-CS-91-18] N92-14653
TEST CHAMBERS
Hypersonic aerodynamics N92-13983
TEST EQUIPMENT
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
TEST FACILITIES
Image-supported navigation for testing instrument landing systems N92-14012
TEST RANGES
Guidance angle measurement of an MLS antenna N92-14011
Factory acceptance test range N92-14016
TEST STANDS
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
TESTS
A framework for test selection [MEMO-INF-91-54] N92-14753
TETHERED SATELLITES
Navigation of the TSS-1 mission N92-14076
THALLIUM
Program complex for problems of atomic physics, part 3 [DE91-636263] N92-14812
THEOREM PROVING
A hyperelliptic diophantine equation related to imaginary quadratic number fields with class number 2 [MEMO-978] N92-14617
Levationis Laus [ITLI-CT-91-08] N92-14622
Census techniques on relativized space classes [ITLI-CT-91-06] N92-14721
On the metamathematics of weak theories [ITLI-ML-91-02] N92-14738
Idempotents [CWI-AM-R9101] N92-14741
Induced circuits in planar graphs [CWI-BS-R9106] N92-14744
THEOREMS
History of constructivism in the twentieth century [ITLI-ML-91-05] N92-14599
The incomplete database [ITLI-CT-91-07] N92-14722
Quasi-injective reductions [ITLI-CT-91-11] N92-14723
On the metamathematics of weak theories [ITLI-ML-91-02] N92-14738
Idempotents [CWI-AM-R9101] N92-14741
Induced circuits in planar graphs [CWI-BS-R9106] N92-14744
The consistency of an extended NaDSet [ITLI-ML-90-11] N92-14768
THEORETICAL PHYSICS
On topological symmetries and the Goldstone Theorem [DE91-634058] N92-14880
THERMAL ABSORPTION
Analysis of lunar regolith thermal energy storage [NASA-CR-189073] N92-14480
THERMAL BATTERIES
Characteristics and development report for the MC3246A thermal battery [DE92-000609] N92-14288
THERMAL CONDUCTIVITY
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites [NASA-TM-105233] N92-14120
THERMAL CYCLING TESTS
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces [NASA-TM-105363] N92-14114
Qualification testing of a diode-laser transmitter for free-space coherent communications [AD-A241728] N92-14335
THERMAL DECOMPOSITION
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
THERMAL EMISSION
Thermal emission spectroscopy of the middle atmosphere N92-14502
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
THERMAL ENERGY
Waste treatment N92-14456
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Solar pumped lasers and their applications N92-14468
Analysis of lunar regolith thermal energy storage [NASA-CR-189073] N92-14480
Solar thermal energy contract list, fiscal year 1990 [DE91-002175] N92-14481
THERMAL EXPANSION
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites [NASA-TM-105233] N92-14120
THERMAL INSULATION
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
Options for reducing carbon dioxide emissions [DE92-000906] N92-14494
THERMAL MAPPING
Thermal wave imaging examples and applications [AD-A240982] N92-14124
THERMAL NEUTRONS
UENDL/NAA: USSR Evaluated Nuclear Data Library for Neutron Activation Analysis [DE91-624093] N92-14809
THERMAL NOISE
Sources of noise in magneto-optical readout N92-14908
THERMAL PROTECTION
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
THERMAL RADIATION
A thermal/nonthermal approach to solar flares [NASA-TM-4323] N92-14956
THERMAL RESISTANCE
Quasi-analogue method for determination thermal contact resistance [DE91-638960] N92-14829
THERMAL STRESSES
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967
THERMOCHEMISTRY
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium [LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows [LR-624] N92-14326
Gas Research Institute experience in solar fuel research N92-14473
Thermochemical energy storage for a lunar base [NASA-TM-105333] N92-14485
THERMODYNAMIC PROPERTIES
Study of improved methods for predicting chemical equilibria [DE91-018803] N92-14129
Theory of ordering transformations in metals and minerals [DE92-000855] N92-14157
Binders for melt castable plastic bonded explosives [AD-D015032] N92-14184
THERMODYNAMICS
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling [NASA-TM-105349] N92-14434
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Structures and thermodynamics of some rare earth sulfides [DE91-018554] N92-14879
THERMOGRAPHY
A 2-D imaging heat-flux gauge [DE92-000153] N92-14332
THERMONUCLEAR REACTIONS
ITER parametric analysis and operational performance [DE91-640901] N92-14861
THERMOPHYSICAL PROPERTIES
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967
THERMOPLASTICITY
Structural mechanics and materials science N92-13989
THERMOSPHERE
The flow of plasma in the solar terrestrial environment [NASA-CR-188812] N92-14955
THICK PLATES
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116

THICKNESS
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
THIN AIRFOILS
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997
THIN FILMS
High temperature static strain gage development
[NASA-CR-189044] N92-14037
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Ceramics derived from organo-metallic precursors
[AD-A241849] N92-14172
Vortex response, dimensionality and fluctuations in high-T(sub c) suuperconductors
[AD-A241850] N92-14284
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322
Materials processing and synthesis N92-14460
Applications of energetic particles in improving coating adhesion properties N92-14461
Pulsed laser processing of solar cells N92-14462
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867
Defect studies in 3-5 thin film semiconductors
[DE92-000052] N92-14875
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
THIN LAYER CHROMATOGRAPHY
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
THIN PLATES
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
THIN WINGS
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997
THREE BODY PROBLEM
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth+Moon elliptic restricted three-body problem
[AD-A241690] N92-14069
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
THREE DIMENSIONAL BODIES
Effect of viscous damping on the response of floating bodies N92-14303
THREE DIMENSIONAL FLOW
The turbomachine blading design using S2-S1 approach N92-13940
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
Numerical investigations in three-dimensional internal flows
[NASA-CR-189467] N92-14313
Parameterization of intermittant turbulence and the vorton method
[DE92-000758] N92-14317
THREE DIMENSIONAL MODELS
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997
Stratospheric dynamics and transport studies N92-14535
THREE DIMENSIONAL MOTION
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035
Vortex ring interaction with a free surface N92-14308
THRUST VECTOR CONTROL
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934
THULIUM COMPOUNDS
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879
TILT ROTOR AIRCRAFT
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933
TIME
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
TIME DEPENDENCE
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751
TIME DIVISION MULTIPLE ACCESS
Laboratory measurements of on-board subsystems N92-14216
On-board processing for telecommunications satellites N92-14227
TIME DIVISION MULTIPLEXING
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
A reconfigurable multicarrier demodulator architecture N92-14213
Multi-rate demodulator architecture N92-14232
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report
[DOT/FAA/CT-TN91/50] N92-14270
TIME FUNCTIONS
Generalization of traveltime inversion
[REPT-91-13] N92-14733
TIME MARCHING
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
TIME MEASUREMENT
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
TIN
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189
TITANIUM ALLOYS
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Hypervelocity launch capabilities to over 10 km/s
[DE92-000242] N92-14377
TITANIUM COMPOUNDS
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420
TITANIUM NITRIDES
Pulsed laser processing of solar cells N92-14462
TITANIUM OXIDES
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
Photocatalyzed removal of multiple contaminants from water N92-14453
TOKAMAK DEVICES
New non-axisymmetric eigenmodes associated with an edge plasma layer
[DE90-798727] N92-14843
Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Current generation by neutral beam injection in a non-circular tokamak
[DE91-636816] N92-14848
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
TOLERANCES (MECHANICS)
On designing for quality N92-13963
TOLLMIEN-SCHLICHTING WAVES
Aeroacoustics N92-13976
TOOLS
Tool exchanger for underwater use N92-14198
TOPEX
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
TOPOGRAPHY
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948
TOPOLOGY
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619
Convergence, continuity and iteration in mathematical morphology
[CWI-BS-R9104] N92-14743
Lindeloef in versus in Lindeloef
[REPT-91-23] N92-14767
TORQUE
Converting a commercial electric direct-drive robot to operate from joint torque commands
[DE92-000611] N92-14687
TORQUE SENSORS (ROBOTICS)
Converting a commercial electric direct-drive robot to operate from joint torque commands
[DE92-000611] N92-14687
TORSION
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
TORSIONAL STRESS
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
The effect of overloads on life-time N92-14430
TORSIONAL VIBRATION
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
TOUGHNESS
Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] N92-14042
TOXICITY AND SAFETY HAZARD
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
TRACE ELEMENTS
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
Thermal emission spectroscopy of the middle atmosphere N92-14502
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Whole air sampler N92-14513
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
Analysis of atmospheric spectra for trace gases N92-14532
Stratospheric dynamics N92-14537
Analysis of observations of the middle atmosphere from satellites N92-14545
Upper Atmosphere Data Program (UADP) N92-14553
TRACTION
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
TRADEOFFS
Expected antenna utilization and overload N92-14248
TRAILING EDGES
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
TRAINING ANALYSIS
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590
TRAINING DEVICES
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588

TRAINING EVALUATION
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590

TRAINING SIMULATORS
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685

TRAJECTORIES
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572

TRAJECTORY CONTROL
Rapid near-optimal aerospace plane trajectory generation and guidance
[NASA-CR-189469] N92-14066
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249

TRAJECTORY OPTIMIZATION
Rapid near-optimal aerospace plane trajectory generation and guidance
[NASA-CR-189469] N92-14066

TRAJECTORY PLANNING
Navigation of the TSS-1 mission N92-14076
Neural networks for military robots N92-14680

TRANSDUCERS
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497

TRANSFER FUNCTIONS
State space formulas for transfer poles at infinity
[CWI-BS-R9108] N92-14748

TRANSFER OF TRAINING
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588

TRANSFER ORBITS
Minimum fuel coplanar aeroassisted orbital transfer using collocation and nonlinear programming N92-14095

TRANSFORMATIONS (MATHEMATICS)
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665

TRANSIENT RESPONSE
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693

TRANSISTORS
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper
[DE92-000599] N92-14287

TRANSITION METALS
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907

TRANSITION TEMPERATURE
Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: A molecular dynamics study
[DE91-623616] N92-14131
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173

TRANSLATING
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-020] N92-14578
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-91-021] N92-14579

TRANSLATIONAL MOTION
Recovering heading for visually-guided navigation
[AD-A241249] N92-14035

TRANSMITTER RECEIVERS
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
FIDEX: An expert system for satellite diagnostics N92-14218

TRANSMITTERS
Guidance angle measurement of an MLS antenna N92-14011
Flexible digital modulation and coding synthesis for satellite communications N92-14235
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335

TRANSONIC COMPRESSORS
Design of transonic compressor cascades using hodograph method N92-13973
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974

TRANSONIC FLOW
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
Blade design and analysis using a modified Euler solver N92-13952
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
Research on inverse methods and optimization in Italy N92-13956
Design optimization of transonic airfoils N92-13961
An inverse method with regularity condition for transonic airfoil design N92-13969
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] N92-14319

TRANSPARENCE
The matching of doubly ambiguous stereograms
[AD-A241251] N92-14587

TRANSPONDERS
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
Testing MLS DME/P transponders and interrogators N92-14020
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
A DME transponder system approach for convertibility, monitoring, and diagnostics N92-14022
Mobile telephony through LEO satellites: To OBP or not N92-14206
FIDEX: An expert system for satellite diagnostics N92-14218
A B-ISDN-compatible modem/codec N92-14229

TRANSPORT AIRCRAFT
On a global aerodynamic optimization of a civil transport aircraft N92-13931

TRANSPORT PROPERTIES
Stratospheric dynamics and transport studies N92-14535
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538
Stratospheric Data Analysis System (STRATAN) N92-14539
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833

TRANSPORTATION
TDC: Innovation in transport N92-14010

TRANSPORTATION NETWORKS
Electronic systems in transportation
[TP-9983] N92-14009

TRAPPING
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821

TREES (MATHEMATICS)
The connectivity of the leaf-exchange spanning tree graph of a graph
[MEMO-959] N92-14711
A note on maximal spanning tree games and Prim's algorithm
[MEMO-968] N92-14717
Minimum basis graphs of weighted matroids
[MEMO-950] N92-14727
Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762

TRELLIS CODING
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030
Multi-stage decoding of multi-level modulation codes N92-14233
Flexible digital modulation and coding synthesis for satellite communications N92-14235
Determinate-state convolutional codes N92-14242

TRIBOLOGY
The puzzles of surface science and recent attempts to explain them
[DE92-000928] N92-14136

TROPICAL METEOROLOGY
Physical processes responsible for ENSO events
[DE91-635166] N92-14569

TROPICAL REGIONS
Analysis of troposphere-stratosphere exchange N92-14552

TROPOSPHERE
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
Radiative flux measurements in the stratosphere N92-14514
Stratosphere-troposphere exchange project management N92-14515
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
Analysis of atmospheric spectra for trace gases N92-14532
Fast two-dimensional model N92-14534
Stratospheric dynamics N92-14537
Stratospheric Data Analysis System (STRATAN) N92-14539
Analysis of troposphere-stratosphere exchange N92-14552

TROUGHS
Photocatalysis with large-scale trough collectors N92-14455

TRUSSES
Space robotics N92-13987

TUNABLE LASERS
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511

TUNGSTEN FLUORIDES
Sequential deposition etch techniques for the selective deposition of tungsten
[DE92-000953] N92-14165

TURBINE BLADES
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
Blade design and analysis using a modified Euler solver N92-13952
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade
[ESA-TT-1180] N92-14168
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
Airfoil Vibration Dampers program
[NASA-CR-188929] N92-14391

TURBINE ENGINES
Technology needs for high speed rotorcraft (3)
[NASA-CR-177592] N92-14039
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179

TURBINE PUMPS
A proposed through-flow inverse method for the design of mixed-flow pumps N92-13941
Limit cycle vibrations in turbomachinery
[NASA-TP-3181] N92-14108
Nonlinear rotordynamics analysis --- Space Shuttle Main Engine turbopumps
[NASA-CR-184263] N92-14344
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359

Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391

TURBINE WHEELS
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357

TURBINES
Muffler for air powered turbine drive [AD-D015034] N92-14062

TURBOFAN ENGINES
International aviation (selected article) [AD-A240987] N92-13992
Theoretical models for duct acoustic propagation and radiation N92-14782
Design and performance of duct acoustic treatment N92-14783

TURBOFANS
Study of a new airfoil used in reversible axial fans N92-13970

TURBOGENERATORS
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347
The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371

TURBOMACHINE BLADES
The turbomachine blading design using S2-S1 approach N92-13940

TURBOMACHINERY
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943
Research on inverse methods and optimization in Italy N92-13956
Limit cycle vibrations in turbomachinery [NASA-TP-3181] N92-14108
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 [NASA-CP-3122] N92-14346
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370

TURBULENCE
An experimental investigation of the separating/reattaching flow over a backstep [NASA-CR-189495] N92-14314
Drop/gas interactions in dense sprays [AD-A241564] N92-14315
Atmospheric propagation N92-14781
The application of experimental data to blade wake interaction noise prediction [NASA-CR-189461] N92-14789

TURBULENCE EFFECTS
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
Direct computation of turbulence and noise [NASA-CR-187616] N92-14788
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt [DE91-623793] N92-14952

TURBULENCE MODELS
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row [RAE-TM-P-1205] N92-14319
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] N92-14328
Modelling of turbulent heat transport: A state-of-the-art [VKI-TM-47] N92-14329
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360

TURBULENT BOUNDARY LAYER
On the mechanism of turbulence suppression in free shear flows under acoustic excitation [NASA-TM-105360] N92-14003
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312

TURBULENT FLOW
On the mechanism of turbulence suppression in free shear flows under acoustic excitation [NASA-TM-105360] N92-14003
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] N92-14004
Particle-laden weakly swirling free jets: Measurements and predictions [NASA-TM-100881] N92-14061
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298
Turbulence measurements in axisymmetric jets of air and helium N92-14299
Turbulence measurements in a submerged jet near a free surface N92-14305
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
An experimental investigation of the separating/reattaching flow over a backstep [NASA-CR-189495] N92-14314
Parameterization of intermittant turbulence and the vorton method [DE92-000758] N92-14317
Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373

TURBULENT HEAT TRANSFER
Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967
Modelling of turbulent heat transport: A state-of-the-art [VKI-TM-47] N92-14329

TURBULENT JETS
Particle-laden weakly swirling free jets: Measurements and predictions [NASA-TM-100881] N92-14061
Turbulence measurements in axisymmetric jets of air and helium N92-14299

TURBULENT MIXING
Jet noise suppression N92-14784
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model [NASA-TM-105338] N92-14795

TURBULENT WAKES
Drop/gas interactions in dense sprays [AD-A241564] N92-14315

TURING MACHINES
Census techniques on relativized space classes [ITLI-CT-91-06] N92-14721

TWINNING
Slip, twinning and transformation in Laves phases [DE92-000764] N92-14163

TWO BODY PROBLEM
Elimination of secular terms from the differential equations for the elements of perturbed two-body motion N92-14085

TWO DIMENSIONAL BODIES
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309

TWO DIMENSIONAL MODELS
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings [NASA-CR-4414] N92-13997
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil [LR-646] N92-14004
The stratospheric residual circulation as deduced from satellite data N92-14498
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Fast two-dimensional model N92-14534

TWO FLUID MODELS
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937

TWO PHASE FLOW
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
Flow boiling with enhancement devices for cold plate coolant channel design [NASA-CR-189518] N92-14892

U

U.S.S.R.
JPRS report: Science and technology. USSR: Space [JPRS-USP-91-007] N92-14101
JPRS report: Science and technology. USSR: Materials science [JPRS-UMS-91-008] N92-14143
JPRS report: Science and technology. USSR: Earth sciences [JPRS-UES-91-006] N92-14439
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-019] N92-14577
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-020] N92-14578
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-021] N92-14579
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-022] N92-14580
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-023] N92-14581
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-91-024] N92-14582
JPRS report: Science and technology. USSR: Physics and mathematics [JPRS-UPM-91-007] N92-14776
JPRS report: Science and technology. USSR: Physics and mathematics [JPRS-UPM-91-006] N92-14777

U.S.S.R. SPACE PROGRAM
JPRS report: Science and technology. USSR: Space. Mishin monograph on failure of Soviet manned lunar program [JPRS-USP-91-006] N92-14068
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246

U-2 AIRCRAFT
The ER-2 meteorological measurement system N92-14510
Ames ER-2 ozone measurements N92-14512

UDIMET ALLOYS
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409

ULTRAHIGH FREQUENCIES
Neural net sensor fusion [AD-A241765] N92-14336
Investigations of freshwater and ice surveying using short-pulse radar [AD-A241435] N92-14440

ULTRAHIGH VACUUM
Applications of ultra-high vacuum technique to surface and near-surface studies [ETN-92-90454] N92-14141

ULTRASONIC RADIATION
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow [DE91-635323] N92-14585

ULTRASONIC WELDING
SNL initiatives in electronic fluxless soldering [DE92-000818] N92-14188

ULTRAVIOLET LASERS
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation [DE92-000859] N92-14341

ULTRAVIOLET PHOTOMETRY
Ames ER-2 ozone measurements N92-14512

ULTRAVIOLET RADIATION
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces [NASA-TM-105363] N92-14114
Chemical models of advanced oxidation processes N92-14447
Effect of light intensity on photocatalytic reaction N92-14449
Ultrox operating experiences with UV/oxidation; economics N92-14451
Measurement of the absolute solar UV irradiance and variability N92-14522

Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943

UNDERGROUND EXPLOSIONS
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557

UNDERWATER ACOUSTICS
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794

UNDERWATER COMMUNICATION
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192

UNDERWATER ENGINEERING
Underwater Technology Symposium
[VTT-120] N92-14190
Tool exchanger for underwater use N92-14198
Optical proximity sensor for underwater manipulator applications N92-14199

UNDERWATER STRUCTURES
Materials behaviour in the deep sea environments N92-14195
Development of a calibration method for deepsea magnetic particle testing N92-14196
Testing a force sensor for underwater magnetic particle inspection N92-14197
Dynamics of risers --- associated with offshore platforms N92-14200

UNDERWATER TESTS
Underwater Technology Symposium
[VTT-120] N92-14190
Pressure chamber for simulation of deep sea conditions N92-14194
Testing a force sensor for underwater magnetic particle inspection N92-14197
Optical proximity sensor for underwater manipulator applications N92-14199

UNDERWATER VEHICLES
Underwater Technology Symposium
[VTT-120] N92-14190
Motion dynamics of submersibles N92-14191
Energy source possibilities in underwater technics N92-14193

UNITED STATES
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926
Arctic Research of the United States, Volume 5 N92-14562

UNIVERSE
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe
[DE91-634422] N92-14940

UNIVERSITY PROGRAM
Annual Research Summary, 1 July 1990 to 30 June 1991 N92-14964

UNSTEADY FLOW
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995

UPLINKING
On-board demux/demod N92-14221
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223

UPPER ATMOSPHERE
NASA Upper Atmosphere Research Program: Research summaries 1988-1989
[NASA-TM-105120] N92-14499
Whole air sampler N92-14513
Upper atmosphere research: Reaction rate and optical measurements N92-14525
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531
Upper atmosphere dynamics N92-14544
Data analysis and archival N92-14551
Upper Atmosphere Data Program (UADP) N92-14553

UPPER ATMOSPHERE RESEARCH SATELLITE (UARS)
Mission and sampling analyses for atmospheric satellite experiments N92-14554

UPPER SURFACE BLOWING
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930

UPSTREAM
On the mechanism of turbulence suppression in free shear flows under acoustic excitation
[NASA-TM-105360] N92-14003

URBAN DEVELOPMENT
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924

USER MANUALS (COMPUTER PROGRAMS)
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618
A bi-directional BAUDOT/ASCII code converter
[RSRE-MEMO-4479] N92-14629

V

VALVES
Hydraulic actuator system for rotor control N92-14363

VANADIUM
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160

VANADIUM ALLOYS
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153

VANES
High temperature static strain gage development
[NASA-CR-189044] N92-14037
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
Ceramic regenerator program
[NASA-CR-189053] N92-14374

VAPOR DEPOSITION
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
Materials processing and synthesis N92-14460
Applications of energetic particles in improving coating adhesion properties N92-14461
Surface modification technologies using concentrated solar radiation N92-14463
Defect studies in 3-5 thin film semiconductors
[DE92-000052] N92-14875

VAPORIZING
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943

VARIABLE SWEEP WINGS
History of EPOS air-launched spaceplane project N92-14103

VARIATIONAL PRINCIPLES
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle
[NASA-CR-189090] N92-14436

VARIATIONS
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258

VECTOR CURRENTS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701

VECTOR QUANTIZATION
Video data compression using artificial neural network differential vector quantization N92-14214

VECTOR SPACES
The algebra of Killing vectors in five-dimensional space
[DE91-635976] N92-14765

VECTORS (MATHEMATICS)
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
A note on maximal spanning tree games and Prim's algorithm
[MEMO-968] N92-14717
The algebra of Killing vectors in five-dimensional space
[DE91-635976] N92-14765

VEGETATIVE INDEX
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442

VELOCITY DISTRIBUTION
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
Generalization of traveltime inversion
[REPT-91-13] N92-14733
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858

VELOCITY MEASUREMENT
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
Turbulence measurements in a submerged jet near a free surface N92-14305

VENTILATION
Study of a new airfoil used in reversible axial fans N92-13970
Appendices B thru F, volume 3
[NASA-CR-184249] N92-14592
Advanced life support study
[NASA-CR-184247] N92-14595

VENUS (PLANET)
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948

VENUS ATMOSPHERE
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

VERTICAL DISTRIBUTION
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
Balloon-borne measurements of polar stratospheric ozone N92-14524

VERTICAL TAKEOFF AIRCRAFT
Technology needs for high speed rotorcraft (3)
[NASA-CR-177592] N92-14039

VERY LARGE SCALE INTEGRATION
Video data compression using artificial neural network differential vector quantization N92-14214
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration
[AD-A241696] N92-14662
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development
[AD-A241698] N92-14664
Automated implementation of rule-based expert systems with neural networks for time-critical applications N92-14670

VERY LONG BASE INTERFEROMETRY
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249

VHSIC (CIRCUITS)
Implications of interoperability and standardization for the industrial base N92-14057
VIBRATION
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades [NASA-CR-189018] N92-14038
Limit cycle vibrations in turbomachinery [NASA-TP-3181] N92-14108
Surface vibrational spectroscopy of pure liquids [DE92-000843] N92-14135
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
VIBRATION DAMPING
Spacecraft dynamics and control N92-13988
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990 [NASA-CP-3122] N92-14346
The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350
Stability of intershaft squeeze film dampers N92-14351
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
Proceedings of Damping 1991, volume 3 [AD-A241313] N92-14386
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391
Active vibration damping of flexible structure [ESA-TT-1217] N92-14438
VIBRATION ISOLATORS
Airfoil Vibration Dampers program [NASA-CR-188929] N92-14391
VIBRATION MEASUREMENT
Rub induced rotor/stator vibration analysis on CF700 engine [NRC-TR-ENG-007] N92-14060
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348
VIBRATION MODE
Structural damage identification using mathematical optimization techniques N92-13936
VIBRATION SIMULATORS
A chaotic system for the generation of extreme mechanical environments [DE91-018358] N92-14388
VIBRATION TESTS
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
A chaotic system for the generation of extreme mechanical environments [DE91-018358] N92-14388
VIDEO DATA
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
Video data compression using artificial neural network differential vector quantization N92-14214
VIDEO EQUIPMENT
Image-supported navigation for testing instrument landing systems N92-14012
VIDEO SIGNALS
Ground wave propagation of a video pulse source, part 2 [DE92-001794] N92-14264
VISCOELASTICITY
Spacecraft dynamics and control N92-13988
VISCOMETRY
Viscometry constants for 1,4 polybutadiene in tetralin at 135C [AD-A241843] N92-14125
VISCOPLASTICITY
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions [DE91-017690] N92-14387
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling [NASA-TM-105349] N92-14434
VISCOUS DAMPING
Effect of viscous damping on the response of floating bodies N92-14303
Proceedings of Damping 1991, volume 3 [AD-A241313] N92-14386
VISCOUS FLOW
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings [NASA-CR-4414] N92-13997
Eighteenth Symposium on Naval Hydrodynamics [LC-91-62359] N92-14300
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe [DE91-634422] N92-14940
VISIBILITY
US Navy regional climatic study of the Barents Sea and adjacent waters [AD-A241115] N92-14566
VISUAL ACUITY
Synthesis of visual modules from examples: Learning hyperacuity [AD-A241159] N92-14683
VISUAL FIELDS
Recovering heading for visually-guided navigation [AD-A241249] N92-14035
VISUAL FLIGHT RULES
Operational survey: VFR heliport approaches and departures [SCT-91RR-26] N92-14033
VISUAL PERCEPTION
The matching of doubly ambiguous stereograms [AD-A241251] N92-14587
VITERBI DECODERS
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211
Multi-stage decoding of multi-level modulation codes N92-14233
VOICE COMMUNICATION
Dialogue structuring [REPT-90-89] N92-14644
VOIDS
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture [DE91-638175] N92-14389
VOLTAGE CONVERTERS (DC TO DC)
Multi-megawatt inverter/converter technology for space power applications [NASA-TM-105307] N92-14294
Silicon device performance measurements to support temperature range enhancement [NASA-CR-189522] N92-14295
VOLTERRA EQUATIONS
A singular nonlinear Volterra integral equation [MEMO-955] N92-14731
VOLUME
Efficient hybrid rendering of volume data and polygons [REPT-91-17] N92-14650
VOMITING
Pharmacological and neurophysiological aspects of space/motion sickness [NASA-CR-189521] N92-14586
VORTEX BREAKDOWN
Parameterization of intermittant turbulence and the vorton method [DE92-000758] N92-14317
VORTEX FILAMENTS
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
Vortex ring interaction with a free surface N92-14308
Parameterization of intermittant turbulence and the vorton method [DE92-000758] N92-14317
VORTEX GENERATORS
Vortex generator design for aircraft inlet distortion as a numerical optimization problem N92-13959
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics [NASA-TM-105321] N92-13998
VORTEX RINGS
Vortex ring interaction with a free surface N92-14308
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
VORTEX SHEDDING
Effect of viscous damping on the response of floating bodies N92-14303
Parameterization of intermittant turbulence and the vorton method [DE92-000758] N92-14317
VORTICES
The turbomachine blading design using S2-S1 approach N92-13940
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
Definition of the unsteady vortex flow over a wing/body configuration [NASA-CR-180083] N92-13995
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics [NASA-TM-105321] N92-13998
Eighteenth Symposium on Naval Hydrodynamics [LC-91-62359] N92-14300
A boundary integral approach in primitive variables for free surface flows N92-14304
Vortex ring interaction with a free surface N92-14308
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES) [VKI-TN-176] N92-14328
The stratospheric residual circulation as deduced from satellite data N92-14498
The application of experimental data to blade wake interaction noise prediction [NASA-CR-189461] N92-14789
VORTICITY
The turbomachine blading design using S2-S1 approach N92-13940
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994
A study on vortex flow control on inlet distortion in the re-engined 727-100 center inlet duct using computational fluid dynamics [NASA-TM-105321] N92-13998
Vortex ring interaction with a free surface N92-14308
Theoretical modelling and meteorological analysis for the AASE mission N92-14542
VSAT (NETWORK)
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205

W

WAFERS
Preoxidation cleaning optimization for crystalline silicon [DE92-000981] N92-14178
WAKES
Eighteenth Symposium on Naval Hydrodynamics [LC-91-62359] N92-14300
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309
WALLS
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311
WAR GAMES
Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN [AD-A241509] N92-14685
WARNING SYSTEMS
Automated baggage threat detection N92-14032
WASTE DISPOSAL
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
WASTE TREATMENT
Waste treatment N92-14456
Solar technology applications in chemical waste management N92-14459
WASTE WATER
Ultrox operating experiences with UV/oxidation; economics N92-14451
WASTES
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
WATER
Surface vibrational spectroscopy of pure liquids [DE92-000843] N92-14135
CNC water-jet machining and cutting center [DE92-000661] N92-14187
Appendices B thru F, volume 3 [NASA-CR-184249] N92-14592
WATER MANAGEMENT
Assimilation of TIR imagery in numerical models as a tool for water management [BCRS-90-36] N92-14441

WATER POLLUTION
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
WATER TREATMENT
Water treatment: Advanced photooxidation processes N92-14446
Chemical models of advanced oxidation processes N92-14447
Solar photocatalyzed process economics N92-14452
Photocatalyzed removal of multiple contaminants from water N92-14453
Immobilized catalysts in solar concentrators N92-14454
Photocatalysis with large-scale trough collectors N92-14455
WATER VAPOR
Radiative flux measurements in the stratosphere N92-14514
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943
WAVE EQUATIONS
Second order wave forces and wave drift damping
[REPT-91-34] N92-14736
WAVE FUNCTIONS
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
WAVE GENERATION
A coupled time and frequency approach for nonlinear wave radiation N92-14301
WAVE INTERACTION
A numerical research of nonlinear body-wave interactions N92-14302
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913
WAVE PROPAGATION
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201
A coupled time and frequency approach for nonlinear wave radiation N92-14301
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Generalization of traveltime inversion
[REPT-91-13] N92-14733
Atmospheric propagation N92-14781
WAVE RESISTANCE
A coupled time and frequency approach for nonlinear wave radiation N92-14301
WAVE SCATTERING
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262
Generalization of traveltime inversion
[REPT-91-13] N92-14733
WAVEFORMS
Generalization of traveltime inversion
[REPT-91-13] N92-14733
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854
WAVEGUIDE ANTENNAS
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
WAVEGUIDES
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915
WAVELENGTHS
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
WEAK INTERACTIONS (FIELD THEORY)
Antiparticles
[DE91-636031] N92-14810
WEAPON SYSTEMS
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Avionics technology beyond 2000 N92-14058
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development
[AD-A241694] N92-14660
WEAPONS DEVELOPMENT
Avionics technology beyond 2000 N92-14058
WEAR
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Filter debris analysis: A concrete approach to wear diagnosis
[DREP-TM-88-20] N92-14345
WEATHER
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
WEATHER FORECASTING
Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575
WEAVING
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
WEIGHTING FUNCTIONS
Multisensor data fusion as applied to guidance and control N92-14681
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product
[REPT-91-35] N92-14737
WELDED JOINTS
Fundamentals of metals joining with lasers
[DE92-000789] N92-14156
Segregation in welded nickel-base alloys
[DE91-624373] N92-14158
The effects of multiple repairs on Inconel 718 weld mechanical properties
[NASA-TM-103559] N92-14380
The effect of yield strength on side-bonding upset welds
[DE92-001605] N92-14396
Stress intensity factors for structural details of welded components N92-14407
WELDED STRUCTURES
Database on fatigue of welded aluminium components ALUFAT N92-14399
Stress intensity factors for structural details of welded components N92-14407
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426
WELDING
Fundamentals of metals joining with lasers
[DE92-000789] N92-14156
The effect of yield strength on side-bonding upset welds
[DE92-001605] N92-14396
WHITE NOISE
Colored noise effects on batch attitude accuracy estimates N92-14093
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
WIDEBAND COMMUNICATION
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
WIND (METEOROLOGY)
Rocket temperature soundings N92-14523
WIND MEASUREMENT
Measurements with SHIRA in the ERS-1 rehearsal campaign
[BCRS-91-03] N92-14444
Rocket temperature soundings N92-14523
WIND TUNNEL CALIBRATION
Hypersonic aerodynamics N92-13983
WIND TUNNEL TESTS
International aviation (selected articles)
[AD-A241119] N92-13993
WIND VELOCITY
Stratospheric chemistry and transport N92-14536
US Navy regional climatic study of the Barents Sea and adjacent waters
[AD-A241115] N92-14566
WIND VELOCITY MEASUREMENT
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570
WING PLANFORMS
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999
WING PROFILES
Research on inverse methods and optimization in Italy N92-13956
WINGLETS
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
WINGS
Review of aerodynamic design in the Netherlands N92-13929
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
An inverse method with regularity condition for transonic airfoil design N92-13969
Definition of the unsteady vortex flow over a wing/body configuration
[NASA-CR-180083] N92-13995
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
WINTER
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
WIRE
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
WORK HARDENING
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures
[DE92-000903] N92-14150

X

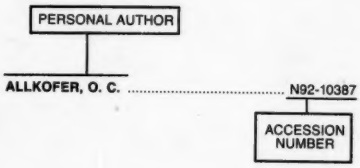
X RAY ABSORPTION
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945
X RAY DIFFRACTION
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
Plotter of pole figure using data from x ray diffraction
[DE91-634207] N92-14868
International Conference on Advanced Methods in X Ray and Neutron Structure Analysis of Materials
[DE91-639071] N92-14871
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x)
[DE92-000898] N92-14873
X RAY INSPECTION
Automated baggage threat detection N92-14032
X RAY LASERS
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Molecular design concept for x ray laser research
[DE92-000972] N92-14343
X RAY SOURCES
A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945
X RAY SPECTRA
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945
X RAY SPECTROSCOPY
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
X RAY TELESCOPES
Solar x ray astronomy rocket program
[NASA-CR-183494] N92-14935
X RAYS
Ionizing radiation survey
[AD-A240966] N92-14253

A search for periodicity in the x ray spectrum of black hole candidate A0620-00
[NASA-CR-186715] N92-14937

Y

YEAST
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
YIELD STRENGTH
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387
The effect of yield strength on side-bonding upset welds
[DE92-001605] N92-14396
YTTERBIUM COMPOUNDS
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879
YTTRIUM
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy
[DE92-000734] N92-14155
YTTRIUM OXIDES
Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x)
[DE92-000898] N92-14873

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The accession number denotes the number by which the citation is identified.

A

AASTROEM, THOMAS N92-14196
ABBAS, MIAN M. N92-14502
N92-14505
ABDEL-GHAFFAR, K. N92-14243
ABSIL, L. H. J. N92-14004
ACTIS, RICARDO LUIS N92-14121
ADACHI, I. N92-14813
ADAMYAN, V. M. N92-14888
ADEGEEST, JOHN N92-14747
ADVANI, S. N92-13982
AFFELT, E. N92-14424
AHALT, STANLEY C. N92-14214
AHMAD, M. N92-14158
AHMED, NISAR N92-14131
AIHARA, H. N92-14813
AIKIN, A. C. N92-14550
AKHTAR, J. I. N92-14158
AKSENOV, V. L. N92-14870
AL-EKABI, HUSSAIN N92-14453
ALBARES, DONALD J. N92-14280
ALBUS, JAMES S. N92-14696
ALESSI, J. G. N92-14799
ALFORD, CECIL O. N92-14657
N92-14658
N92-14659
N92-14660
N92-14661
N92-14662
N92-14663
N92-14664
ALIBAKHSH, M. N92-14661
ALIFANOV, OLEG M. N92-13966
ALLEN, J. E., JR. N92-14525
ALLEN, S. M. N92-14163
ALTHAUS, JOSEF N92-14363
ALZAHABI, B. N92-13935
AMIRKHANOV, I. V. N92-14708
AN, C.-F. N92-13955
ANDERSON, A. E. N92-14483
ANDERSON, BERNHARD H. N92-13959
N92-13998
ANDERSON, DON L. N92-14949
ANDERSON, L. N92-14629
ANDERSON, W. L. N92-14037
ANGENIOL, BERNARD N92-14678
ANOSHIN, A. I. N92-14701
ANTHONY, D. N92-14305
ANTONIAK, Z. I. N92-14174
APTUKOV, VALERY N. N92-13964
N92-13965
ARCONE, STEVEN A. N92-14440
ARENDALE, W. F. N92-14134
ARGENTAR, HAROLD N92-14184
ARNOLD, S. M. N92-14434
ARTYUKHIN, EUGENE A. N92-13967
ASHRAFI, S. N92-14081
ASKEW, RAY N92-14295
ASVELD, PETER R. J. N92-14756
ATAMANCHUK, T. M. N92-13978
ATTISHA, M. R. N92-14029
AUDETTE, MAURICE N92-14032
AVANESOV, G. A. N92-14102
AVNI, MICHA N92-14009
AVRON, MORDHAY N92-14477

B

BAAS, S. M. N92-14632
BABINEAU, DAVID N92-14024
BADDELEY, A. J. N92-14763
BAGCHI, ARUNABHA N92-14379
BAILEY, JIM P. N92-14394
BAILEY, R. S. N92-14037
BAILEY, SHEILA G. N92-14111
BAKER, DAVID F. N92-14084
N92-14091
BAKKER, ERWIN M. N92-14745
N92-14762
BAKKER, MIENTE N92-14655
BALACHANDRAN, U. N92-14291
BALDWIN, RONALD G. N92-14566
BALS, JOHANN N92-14438
BANERDT, W. BRUCE N92-14949
BAR-ITZHACK, I. Y. N92-14092
BARODDY, EDWARD E. N92-14184
BARRON, R. M. N92-13955
BARTLETT, D. C. N92-14187
BARTOLOTTA, PAUL A. N92-14433
BASKHARONE, ERIAN N92-14357
BATCHELOR, D. B. N92-14265
BATCHO, P. N92-14788
BATES, J. M. N92-14174
BAUDRY, G. N92-14426
BAUER, R. N92-14375
BAUMANN, ERIC D. N92-14294
BAVINCK, H. N92-14737
BAYNE, C. K. N92-14127
BEAGLEY, STEPHEN REUBEN N92-14498
BECHT, DAVID G. N92-14359
BECK, R. N92-14306
BECKER, A. N92-14018
BEKLEMISHEV, A. D. N92-14845
BELL, HERBERT H. N92-14067
BELL, R. A. N92-13958
BELL, WAYNE E. N92-14270
BELOUSOV, VALENTIN L. N92-13965
BELVIN, W. KEITH N92-14394
BELYAEV, V. M. N92-14881
BELZER, L. I. N92-14817
BENCHERIF, L. N92-13940
BENKA, STEPHEN G. N92-14956
BENNER, D. CHRIS N92-14529
BENOCCI, A. N92-14329
BENOCCI, C. N92-14328
BENSEL, L. W. N92-14034
BENSER, EARL T. N92-14110
BENSMAN, D. A. N92-14262
N92-14263
BENSON, BRIAN N92-14134
BENTLY, DONALD E. N92-14370
BERARDUCCI, ALESSANDRO N92-14738
BERG, M. N92-14413
N92-14419
N92-14420
BERGERON, D. N92-13979
BERGHUIS, H. N92-14692
BERGMANN, J. W. N92-14405
N92-14424
BERKOWITZ, C. M. N92-14492
BERKOWITZ, STUART J. N92-14032
BERMAN, C. N92-14788
BERMAN, JOEL M. N92-14457
BERNACKI, BRUCE E. N92-14905
BERNAL, L. N92-14305
N92-14308
BERNARD, J.-L. N92-14426
BERNITSAS, MICHAEL M. N92-13935
BESHEARS, D. L. N92-14332
BESTMAN, A. R. N92-14337
N92-14585
BETHKE, KARL-HEINZ N92-14269
BEUGELSDIJK, T. J. N92-14901
BEUMLER, T. N92-14421
BEVILACQUA, RICHARD M. N92-14509
BEWLEY, T. R. N92-14327
BEYKO, E. N92-13935
BIBYK, STEVEN B. N92-14214
BILANOW, STEPHEN N92-14093
BILGEN, ERTUGRUL N92-14474
BILHAM, ROGER N92-14560
BINGHAM, PHILIP R. N92-14662
BIRMAN, KENNETH N92-14656
BLACKMORE, G. W. N92-14139
BLACKSHEAR, W. T. N92-14535
BLAGOJEVIC, B. N92-13980
N92-13989
BLAKE, CHRISTOPHER L. N92-14053
BLANC, J. P. C. N92-14698
BLANC, PHILIPPE N92-14324
BLANKEN, HENK M. N92-14633
N92-14640
N92-14918
BLEVIS, B. C. N92-14011
BLOEBAUM, CHRISTINA L. N92-14041
BLUM, M. G. N92-13989
BOATMAN, JOEY F. N92-14564
BODHAINE, BARRY A. N92-14564
BODLAENDER, HANS L. N92-14746
BODYAGIN, V. A. N92-14817
BOGDANOVA, N. B. N92-14707
N92-14887
BOLDMAN, DONALD R. N92-14002
BOLLER, C. N92-14427
BOLOTIN, YU. L. N92-14749
BOLVIN, D. T. N92-14074
BONATAKI, E. N92-13942
BOND, VICTOR R. N92-14085
BORELLA, H. M. N92-14332
BORGES, JOAO EDUARDO N92-13941
BORISOV, B. A. N92-14173
BOURNE, N. K. N92-14181
BOURRET, E. D. N92-14876
BOUWMAN, PIM N92-14570
BOWEN, B. ARCHIE N92-14676
N92-14679
BOWEN, STEPHEN N92-14562
BOWMAN, C. N92-14014
BOWSER, R. C. N92-13989
BOYD, RONALD D. N92-14892
BOYER, K. N92-14343
BRAITHWAITE, T. H. N92-13989
BRANAGAN, LYLE N92-14366
BRANDECKER, B. N92-14428
BRANDRETH, M. N92-14624
BRASUNAS, J. C. N92-14502
BRAULT, J. W. N92-14531
BRAUSCH, J. F. N92-14784
BREWTON, DAVID W. N92-14040
BRIGGS, H. C. N92-14247
BRINKSMA, ED N92-14753
BRIOT, ROLAND N92-14877
BROERSMA, H. J. N92-14711
BROKOF, U. N92-14012
BROMSTEAD, JAMES N92-14295
BROWELL, EDWARD V. N92-14518
BROWER, WILLIAM A., JR. N92-14566
BROWN, I. N92-14155
BROWN, JERRY N92-14562
BROWN, L. R. N92-14531
BROWN, LEWIS M. N92-14478
BROWN, N. E. N92-14293
BROWN, OTIS N92-14574
BROWN, R. C. N92-14803
BROWNER, R. F. N92-14126
BRUCE, PHILIP D. N92-14590
BRUCKNER, ERIC J. N92-14114
BRUECKNER-FOIT, A. N92-14424
BRUNER, ANNE M. N92-14394
BRUNO, R. N92-14205
BRY, PIERRE-FRANCOIS N92-13938
BRYK, D. C. N92-14124
BUCCI, R. J. N92-14151
BUCKINGHAM, J. N92-14008
BUDANOV, YU. A. N92-14827
BUDEN, D. N92-14951

BUDINGER, JAMES N92-14235
BUDZANOWSKI, A. N92-14835
BUELL, RUEDIGER H. N92-14959
BUETTNER, H. M. N92-14264
BULZAN, DANIEL L. N92-14061
BURKE, JAMES J. N92-14902
BURMESTER, C. P. N92-14867
N92-14873
BURNS, A. R. N92-14137
BURRIS, JOHN N92-14507
N92-14528
BUSCHE, R. M. N92-14185
BUTLER, JAMES N92-14507
N92-14528
BUTLER, RHETT G. N92-14949
BUXBAUM, O. N92-14397
N92-14398
BYRNE, S. T. N92-14154

C

CABUK, H. N92-13957
CALISE, A. J. N92-14066
CAMERON, P. G. N92-13989
CAMY-PEYRET, C. N92-14501
CANEPA, FRANCO N92-14065
CAO, YUSONG N92-14306
CAPLIN, J. N92-13995
CARLI, BRUNO N92-14503
CARMAN, JESSIE CATON N92-14794
CARPENTER, B. N92-14008
CARPENTER, C. A. N92-14176
CARROLL, K. A. N92-13988
CARROLL, THOMAS L. N92-14376
CARTER, M. N92-14265
CARUSONE, J. N92-13987
CASCIOLA, C. N92-14304
CASO, GREGORY S. N92-14232
CASPERSON, D. E. N92-14339
CASPI, S. N92-14778
CAVATORTA, ENRICO N92-13998
CEDAR, R. D. N92-13958
CEDER, G. N92-14147
N92-14148
CENKCI, MARTHA J. N92-14764
CHACKERIAN, C., JR. N92-14527
CHAMDANI, J. I. N92-14664
CHAMIS, CHRISTOS C. N92-14118
N92-14122
CHAN, K. ROLAND N92-14510
CHAN, MAY L. N92-14182
CHAN, Y. S. N92-13985
CHANA, K. S. N92-14319
CHANCE, K. V. N92-14530
CHANDRA, S. N92-14548
CHANG, S. C. N92-14282
CHANG, S. J. N92-14387
CHARNY, B. N92-14250
CHASE, LLOYD N92-14465
CHAVIAROPOULOS, P. N92-13942
CHEKANOV, V. A. N92-14173
CHEN, CE N92-14842
CHEN, D. N92-14045
CHEN, P. N92-14341
N92-14815
CHEN, T. L. C. N92-13989
CHEN, XI N92-13968
CHEN, ZUOYI N92-13973
N92-13974
CHENG, JIASHUN N92-14854
CHENG, SHANGMO N92-13947
CHERNOV, A. A. N92-14848
CHERPILLOD, T. N92-13987
N92-13988
CHEUNG, K.-M. N92-14240
CHEVALIER, ROGER A. N92-14944
CHHABILDAS, L. C. N92-14104
N92-14105
N92-14377
CHI, MICHELENE T. N92-14684
CHIA, V. N92-14155
CHIKILEV, O. G. N92-14805
CHIKUNOV, V. V. N92-14855
N92-14856
CHILDS, DARA W. N92-14357
N92-14358
CHING, M. N92-14224
CHISHOLM, D. M. N92-13982
CHITRE, D. M. N92-14207
CHRISTIANSEN, WALTER H. N92-14467
CHU, D. N92-14078
N92-14150
CHU, PONG P. N92-14228
CHU, WILLIAM P. N92-14506
CHU, XIUZHONG N92-14854
CHUGREEV, YU. V. N92-14884
N92-14946
CHUM, HELENA L. N92-14476
CINICULK, M. K. N92-14175
CLARK, GEORGE W. N92-14937
CLEGG, ANDREW WALLACE N92-14936
CLEMENS, BRUCE M. N92-14460
CLEMENT, P. N92-14734
CLEMENTS, NANCY L. N92-14048
CLEVERS, J. G. P. W. N92-14442
COBBLE, J. A. N92-14339
COHEN, E. N92-14531
COHEN, J. W. N92-14770
COHEN, M. N92-14866
COHEN, R. E. N92-14125
COLEMAN, R. N92-14388
COLLINS, O. N92-14241
N92-14242
COLLINS, THOMAS R. N92-14657
N92-14658
N92-14659
COLOZZA, ANTHONY J. N92-14480
CONDON, ESTELLE N92-14515
N92-14516
CONNOLLY, JOHN S. N92-14470
CONNOR, BRIAN J. N92-14508
N92-14509
CONRATH, B. J. N92-14502
CONWAY, SCOTT N92-14039
COOK, R. N92-14166
COOK, R. L. N92-14862
COOK, ROBERT M. N92-14391
COOMES, E. P. N92-14107
CORBAN, J. E. N92-14066
CORE, P. W. N92-14624
CORKILL, J. N92-14866
COSTELLO, DANIEL J., JR. N92-14211
N92-14233
COTTINGAME, W. B. N92-14821
CRABB, C. A. N92-14029
CRAFWORD, H. J. N92-14942
CRAIGHEAD, I. A. N92-14371
CRAMPTON, GEORGE H. N92-14586
CRESPIREGHIZZI, STEFAN N92-14606
CROCKER, G. W. N92-13988
CUMMINGS, DANIEL G. N92-14169
CUPP, RICHARD E. N92-14564
CURLETT, BRIAN P. N92-14063
CURRAN, FRANCIS M. N92-14109
CURRIE, I. F. N92-14624
CURTAIN, RUTH F. N92-14699
CUSWORTH, R. A. N92-13978
CUTTS, D. N92-14825

D

DAGLE, J. E. N92-14107
DAIGLE, GILLES A. N92-14781
DALEY, PETER S. N92-14459
DAMAREN, C. J. N92-13988
DAMSMA, MARTIN N92-14730
DANIELSEN, EDWIN F. N92-14551
DANILKIN, S. A. N92-14160
DANTZIG, JONATHAN A. N92-13944
DANZER, G. N92-14411
DATELLIS, C. E. N92-14796
DAUSKARDT, R. H. N92-14164
DAVIDSON, R. C. N92-14850
DAVIES, W. E. R. N92-13980
DAVIS, PAUL M. N92-14949
DAVISON, B. H. N92-14185
DEBERG, MARK N92-14769
DEBOER, FRANK S. N92-14651
N92-14654
DEBRY, B. N92-13995
DEFIGUEIREDO, D. G. N92-14734
DEFONTAINE, D. N92-14147
N92-14148
DEGROEN, P. J. M. N92-14296
DEHAAN, LAURENS N92-14761
DEHOFF, RONALD L. N92-14064
DEISSLER, ROBERT J. N92-14322
DEJONG, C. D. N92-14097
DEKKERS, ARNOLD L. M. N92-14761
DEKONING, W. L. N92-14693
DELAURIER, J. D. N92-13977
DELEEUW, J. H. N92-13981
DELEUTERIO, G. M. T. N92-13987
N92-13988
DELLAPENNA, E. N92-13976
DELLINGER, BARRY N92-14457
DELUISI, JOHN J. N92-14564
DERUITER, JOHN N92-14219
DESCHAMBAULT, R. L. N92-13983
DETORE, JACK N92-14039
DEUTSCHMANN, J. N92-14092
DEVALK, C. F. N92-14441
DEVENPORT, W. J. N92-14312
DEVENPORT, WILLIAM J. N92-14789
DEVER, JOYCE A. N92-14114
DEVI, V. MALATHY N92-14529
DEVITO, B. N92-14799
DEVREUGHT, J. P. M. N92-14643
DEVRIES, JOHANNES WEITZE N92-14575
DEWAAL, P. R. N92-14698
DEWAARD, H. N92-14693
DEWEGER, B. M. M. N92-14617
DICK, G. J. N92-14238
DIDZIULIS, S. V. N92-14375
DIETERICH, K. N92-14403
DIFILIPPO, FRANK N92-14485
DIGAETANO, J. O. N92-14796
DIKANSKY, N. N92-14830
DIVECHA, A. P. N92-14291
DODGE, FRANKLIN T. N92-14320
DOETS, KEES N92-14622
DOGGETT, J. N92-14860
DOLL, C. E. N92-14074
N92-14075
N92-14082
DOMINGUEZ, F. N92-14165
DOMINIQUE, H. P. N92-14345
DOMMERMUTH, D. N92-14311
DONG, G. N92-14216
N92-14227
DOSER, M. N92-14813
DOUGLASS, ANNE R. N92-14534
N92-14538
N92-14547
DOW, A. N92-14767
DOWNIE, M. N92-14303
DRECHSLER, S. L. N92-14870
DREYER, K. A. N92-14264
DREYSSE, H. N92-14147
DROBIN, V. M. N92-14177
DROBOT, A. N92-14265
DU, Q. N92-14135
DUC, J. M. NGUYEN N92-13940
DUDEBOUT, R. N92-13978
DUDNIKOV, V. G. N92-14828
DUENNEBIER, FREDERICK K. N92-14949
DULIKRAVICH, GEORGE S. N92-13928
N92-13954
DUNHAM, J. N92-14071
DURAN, J. C. N92-14292
DURKIN, JOHN N92-14215
N92-14218
DYACHKOV, E. I. N92-14177
DYAKOV, V. E. N92-14859
DYER, C. S. N92-14099
DZYUBA, V. A. N92-14812

E

EASTER, R. C. N92-14492
EATON, DAVID F. N92-14469
ECKMAN, R. S. N92-14535
EDELMAN, SHIMON N92-14683
EDWARDS, BERNELL J. N92-14588
EERTINK, HENK N92-14637
EGBERTS, PAUL N92-14766
EGGERS, H. N92-14415
EHNTRALGO, EH. EH. N92-14818
EKE, F. O. N92-14088
EL-GAMAL, M. Z. N92-14011
N92-14014
EL-SHAFEI, A. N92-14351
ELDRED, D. B. N92-14247
ELETSKIJ, V. L. N92-14881
ELLIOTT, D. S. N92-14842
ELLIOTT, KENNY B. N92-14394
ELLIOTT, W. G. N92-13969
ELLIS, DAVID L. N92-14120
ELROD, B. N92-14073
ELVIRA, V. D. N92-14292
ELVIS, MARTIN N92-14939
EMBLETON, TONY F. W. N92-14781
ENG, M. N92-14221
EPEMA, D. H. J. N92-14646
ERIKSON, CAROL A. N92-14217
ERSHOV, A. A. N92-14817
ERWIN, J. KEVIN N92-14904
N92-14912
ERWIN, K. E. N92-14909
ERWIN, R. N92-14008
ESLINGER, P. W. N92-14614
EVANS, JAMES M. N92-14087
EVANS, R. H. N92-14007
EVANS, ROBERT N92-14574
EVERSMAN, WALTER N92-14782

EVSEEV, V. A. N92-14173

F

FABIEN, S. M. N92-14075
FAETH, G. M. N92-14315
FAHLE, MANFRED N92-14683
FAIGLE, U. N92-14717
FAIRLIE, DUNCAN N92-14545
FARGNOLI, J. N92-14222
FARIN, JUHO N92-14193
FARIS, FARIS N92-14203
FARISH, T. N92-14686
FARRINGTON, G. C. N92-14289
FASSNACHT, FRANCIS B. N92-14281
FATEMI, NAVID S. N92-14111
FAURE, J. C. N92-14042
FEATHER, THOMAS E. N92-14032
FEATHER, TIMOTHY D. N92-14791
FEDERICO, PAT-ANTHONY N92-14685
FEHER, KAMILO N92-14234
FEKETE, ALAN N92-14254
FELIPPA, CARLOS A. N92-14383
N92-14392
N92-14393
N92-14436
FENDORF, M. N92-14867
N92-14873
FENSKE, GEORGE R. N92-14461
FERGUSON, S. N92-13980
FERRANDO, W. A. N92-14291
FERRANT, P. N92-14301
FERRY, G. V. N92-14517
FIALA, A. D. N92-14086
FIELD, J. E. N92-14181
FIELDS, C. L. N92-14463
FIELDS, JAMES M. N92-14780
FIFER, ROBERT A. N92-14180
FILLA, O. N92-14078
FINAN, WILLIAM F. N92-14272
FIRESTONE, R. B. N92-14609
FISCHER, TERENCE N92-14034
FISCHMEISTER, H. N92-14424
FISHBEIN, G. N92-13984
FLAGELLO, D. G. N92-14911
FLANAGAN, M. J. N92-14252
FLANAGAN, PATRICK R. N92-14608
FLANNERY, C. N92-14526
FLANNERY, M. R. N92-14802
FLAUD, J. M. N92-14501
FLEISCHAUER, PAUL D. N92-14375
FLEMING, J. G. N92-14165
FLORJANCIC, S. N92-14362
FOLTA, DAVID C. N92-14073
N92-14084
FOMIN, SERGEI A. N92-13947
FONG, C. VANESSA N92-14028
FORBRICH, D. N92-13951
FORCH, B. E. N92-14334
FORD, J. L. N92-14483
FOSTER, J. M. N92-14624
FOX-RABINOVITZ, MICHAEL N92-14539
FRAIETTA, MICHAEL F. N92-14085
FRANCO, M. M. N92-14244
FRANK, P. D. N92-13933
FRANKENA, JAN F. N92-14714
FRANKLIN, JERROLD E. N92-14374
FRANKLIN, WESLEY D. N92-14367
FRANKS, PHALA L. N92-14566
FREAR, D. R. N92-14159
N92-14188
FREEDMAN, I. N92-14079
N92-14080
FRIESEL, M. A. N92-14395
FRISCHBIER, J. N92-14420
FRITZ, BERNARD S. N92-14110
FROEHLICH, F. F. N92-14909
N92-14912
FU, H. N92-14907
FUJI, ZHANG N92-14726
N92-14727
N92-14729
FUJII, KOZO N92-13930
FULTON, R. D. N92-14339

G

GAIER, JAMES R. N92-14170
GAINES, STEVEN E. N92-14551
GALAMBOS, J. D. N92-14861
GALBAATAR, T. N92-14870
GALLIDEPARATESI, G. N92-14606
GALLIVAN, K. N92-14603
N92-14652
GAO, YUNXIA N92-14854
GARCIA, MARIA M. N92-14536
GARYANTES, M. F. N92-14250
GASATI, G. N92-14705
GEBHARDT, JOSEPH J. N92-14171
GEERTS, BART N92-14563
GELLER, MARVIN A. N92-14538
GELMI, L. N92-14701
GENOLINI, S. N92-14606
GEORGE, E. P. N92-14145
GERASIMOV, A. N92-14704
GERHARZ, J. J. N92-14411
N92-14416
GIESEKING, STEPHEN N92-14660
GILDING, B. H. N92-14731
GILES, R. C. N92-14906
N92-14907
GILLEN, V. A. N92-14820
GILMORE, PAUL C. N92-14768
GINZBURG, S. L. N92-14285
GIVER, L. P. N92-14527
GLADDEN, ERNESTINE T. N92-14895
GLASS, I. I. N92-13986
GLAZE, WILLIAM H. N92-14447
GLEGG, STEWART A. L. N92-14789
GLENDENNING, N. K. N92-14941
GLENN, B. N92-14484
GLIEBE, P. R. N92-14784
GLOSSOP, N. D. N92-13980
GOETTING, H. C. N92-14412
N92-14415
GOLDBERG, V. R. N92-14483
GOLDMAN, AARON N92-14501
N92-14506
N92-14532
GOLDMAN, V. V. N92-14720
GONCHAR, V. YU. N92-14749
GONG, I.-Y. N92-14307
GONG, LI N92-14656
GOODMAN, J. K. N92-14517
GOORVITCH, D. N92-14527
GORDLEY, LARRY L. N92-14545
GORDON, G. N92-14788
GORDON, STEVEN C. N92-14069
GOREMYCHKIN, E. A. N92-14869
GORSKI, J. N92-14309
GOTSIS, PASCAL K. N92-14122
GOTTLIEB, J. J. N92-13979
N92-13983
N92-13985
GOTZMER, CARL N92-14184
GOUVEIA, F. J. N92-14488
GOVIND, GIRISH N92-14670
GRAF, W. O. N92-13982
GRAHAM, D. P. W. N92-13987
GRAHAM, J. N92-14303
GRAHAM, JOHN N92-14457
GRAMLING, C. J. N92-14072
GRANT, H. P. N92-14037
GRANT, M. N92-14226
GRANT, P. R. N92-13982
GRANT, R. W. N92-14278
GRAYBEAL, JOHN M. N92-14284
GREEN, STEVEN T. N92-14320
GREENE, EMILY ALICE N92-14496
GREFEN, PAUL W. P. J. N92-14666
GREFF, E. N92-13951
GREGORY, D. L. N92-14388
GREGORY, GERALD L. N92-14520
GREIN, H.-D. N92-13950
GRENIER, PHILIPPE N92-14584
GRIBOV, YU. N92-14852
GRIBUSHIN, A. M. N92-14817
GRIGOREV, N. L. N92-14962
GRIMM, M. J. N92-14250
GROENEBOOM, PIET N92-14757
GRONSKY, R. N92-14866
N92-14867
N92-14873
GROSE, WILLIAM L. N92-14535
N92-14545
GROSSMAN, B. N92-13961
GROSSMANN, W. N92-14265
GROTH, C. P. T. N92-13979
N92-13985
GRUBIN, H. L. N92-13972
GU, CHUANGANG N92-13968
N92-13970
GU, MAOXIANG N92-14302
GUAN, LING N92-14032
GUIBERT, L. N92-14050
GULKIS, S. N92-14251
GUNTER, EDGAR J. N92-14366
GUNTER, R. L. N92-14564
GUO, JINGRONG N92-13973
N92-13974
GUPTA, MOOL C. N92-14915
GUTHRIE, PAUL D. N92-14533
N92-14534
GUTSCHOW, TODD N92-14677
N92-14682
GYEKENYESI, JOHN Z. N92-14433

H

HAAG, THOMAS W. N92-14109
HAFTKA, R. T. N92-13961
HAGGAG, F. M. N92-14154
HAGGANS, CHARLES W. N92-14913
HAGGERTY, JAMES J. N92-14931
N92-14932
HAJJAR, ROGER A. N92-14903
HALPERN, M. B. N92-14703
HAMILL, PATRICK N92-14540
HAMILTON, THOMAS T. N92-14945
HAMMOND, RUSSELL E. N92-14281
HAMMOUD, AHMAD N. N92-14294
HANSEN, FREDERICK N92-14801
HANSEN, J. S. N92-13989
HANSON, A. W. N92-14007
HARASGAMA, S. P. N92-14319
HARDY, J. R. N92-14865
HARIHARAN, S. N92-14381
HARRISON, EDWIN F. N92-14554
HART, R. C. N92-14075
N92-14083
HARTEMINK, FRANS N92-14648
HARTWICH, P. N92-14310
HARVEY, GALE A. N92-14529
HARWIT, ALEX N92-14209
HASAN, M. M. N92-14323
HASKINS, P. S. N92-14099
HATCHER, RICHARD N92-14134
HAVERKORT, BOUDEWIJN R. N92-14639
N92-14755
HAWBOLDT, R. J. N92-13985
HAWKEN, D. F. N92-13979
N92-13983
N92-13985
HAWKINS, L. A. N92-14369
HAWKINS, LARRY A. N92-14359
HAYASHIDA, ROBERT D. N92-14367
HAYBALL, C. N92-13977
HAYKIN, SIMON N92-14026
HAZEWINKEL, MICHIEL N92-14742
HEAPS, WILLIAM S. N92-14500
N92-14507
N92-14528
HECHT-NIELSEN, ROBERT N92-14677
N92-14682
HEIDENREICH, R. N92-14424
HEIJENK, GEERT J. N92-14266
HEIJMANS, H. J. A. M. N92-14743
HEINBOCKEL, JOHN H. N92-14333
HELGESON, W. D. N92-14864
HELM, M. N92-14778
HEMACHANDRA, LANE A. N92-14723
HEMMATI, F. N92-14229
HENDRICKS, KYLE J. N92-14253
HENKENS, LEON N92-14648
HENSHAWS, ANDREW N92-14660
HERD, MELVIN D. N92-14169
HERMAN, GERARD C. N92-14733
HERMAN, J. R. N92-14502
HERMAN, R. G. N92-14138
HERMANS, A. J. N92-14736
HERSHCOVITCH, A. I. N92-14799
HERTEL, E. S. N92-14104
N92-14105
HESS, P. W. N92-14291
HEULER, P. N92-14429
HICKS, T. A. N92-14022
HIETALA, V. M. N92-14378
HILDRETH, ELLEN C. N92-14035
HILL, S. A. N92-14104
N92-14105
HILLMAN, J. J. N92-14531
HILTON, MICHAEL R. N92-14375
HIN, ANDREAS J. S. N92-14650
HIPSKIND, R. STEPHEN N92-14551
HIPSKIND, STEVE N92-14516
HITCHCOCK, LLOYD N92-14034
HIZLAN, M. N92-14242
HO, HING W. N92-14435
HO, Y. N92-14282
HO, Y. L. N92-14265
HOBBACHER, A. N92-14399
N92-14407
HODGE, CHARLES G. N92-14787
HOEDE, CORNELIS N92-14712
N92-14728

HOERIG, CRAIG N92-14235
HOFTUN, J. S. N92-14825
HOGERVORST, BAS J. N92-14718
N92-14725
HOLLAND, R. N92-14139
HOLMBERG, GERALD N92-14839
HOLMES, R. N92-14349
HOLMES, SUSAN J. N92-14565
HONG, T. N92-13988
HOOFMAN, RAYMOND N92-14740
HOPMAN, H. N92-14851
HOPPE, A. N92-13962
HORSHAM, GARY A. P. N92-14649
HORTA, LUCAS G. N92-14394
HORTON, G. C. N92-14319
HORZELA, A. N92-14891
HOSKING, F. M. N92-14188
HOU, P. Y. N92-14155
HOU, SHAOLIE N92-14138
HOUCK, MICHAEL R. N92-14067
HOUSE, G. N92-14221
HOUSTON, SUSAN H. N92-14017
HOUTSMA, MAURICE A. W. N92-14712
N92-14918
HU, HAOTIAN N92-14854
HU, J. T. C. N92-13978
HU, Y. F. N92-14605
HUANG, J. Y. N92-14135
HUANG, JEN-KUANG N92-14390
HUANG, PAO S. N92-13998
HUANG, SONG N92-14670
HUBBARD, DAVID C. N92-14588
HUBBARD, HARVEY H. N92-14779
HUDSON, ROBERT D. N92-14546
HUECK, M. N92-14400
N92-14429
HUGHES, P. C. N92-13987
N92-13988
HUGHES, R. J. N92-14821
HUIJBERTS, H. J. C. N92-14688
HULSE, C. O. N92-14037
HULSHOFF, S. N92-13977
HUNKLER, L. T., SR. N92-14330
HUNT, ARLON J. N92-14472
HUNTLEY, J. M. N92-14181
HUTH, H. N92-14413

I

IBRAHIM, MOUNIR N92-14002
IEK, CHANTHY N92-14002
IKONEN, KARI N92-14200
INDAHENG, R. N92-14661
INUKAI, THOMAS N92-14203
N92-14208
N92-14225
ISHIDA, A. N92-14844
ISHIKAWA, A. N92-14872
ISII, KUNIYOSHI N92-14348
IVANCIC, WILLIAM D. N92-14204
IVANOC, A. A. N92-14857
IWATSUBO, T. N92-14361
IZRAILEV, F. M. N92-14705
N92-14831

J

JAANIMAGI, P. N92-14330
JACKMAN, CHARLES H. N92-14533
N92-14534
N92-14547
JACKSON, E. N92-14788
JACKSON, J. N92-14071
JACKSON, TIMOTHY C. N92-14076
JACKSON, W. D. N92-14124
JACQUOTTE, OLIVIER-PIERRE N92-13938
JAECKELS, H. N92-14424
JALBY, W. N92-14603
N92-14652
JAMALI, M. M. N92-14213
JANES, ROBERT N92-14016
N92-14024
JANSSEN, M. M. J. F. N92-14824
JELLISON, J. L. N92-14156
JENNISON, D. R. N92-14137
JIANG, L.-Y. N92-13978
JOH, C.-Y. N92-13961
JOHNSON, C. B. N92-14330
JOHNSON, C. R. N92-14825
JOHNSON, JOHN L. N92-14838
JOHNSON, R. WAYNE N92-14295
JOHNSON, W. A. N92-14275
JOHNSTON, G. W. N92-13976
N92-13977
N92-13979
JOHNSTON, P. V. N92-14506
JONES, J. N92-14484
JONES, L. A. N92-14339
JONES, O. C. N92-13937
JONES, R. A. N92-14803
JONES, R. H. N92-14395
JONES, R. L. N92-14541
JONES, RANDOLPH M. N92-14684
JONES, RICKIE N92-14034
JONES, T. L. N92-14075
JONKER, C. M. N92-14919
JORDAN, ARTHUR K. N92-14256
JORDAN, J. E. N92-14031
JORDENSE, MARCEL A. N92-14266
JOVIC, SRBOLJUB N92-14314
JUNG, L. N92-14430
JUNG, S. Y. N92-14352
N92-14353

K

KABANTSEV, A. A. N92-14858
KACA, J. N92-13986
KACHMAN, N. N92-14308
KALSKE, SEPPO N92-14191
KAMMEYER, P. C. N92-14086
KANA, DANIEL D. N92-14320
KANERVA, PENTTI N92-14695
KANG, CHANG-GU N92-14307
KANLOEV, A. M. N92-14874
KANN, J. L. N92-14909
KANT, GOOS N92-14746
KAPOOR, A. N92-14073
KAPPES, M. N92-14221
KAPUSCIK, E. N92-14891
KARMARKAR, S. D. N92-14291
KARNIADAKIS, G. N92-14788
KARUZA, S. K. N92-14275
KASAMI, TADAO N92-14233
KASCAK, A. F. N92-14365
KAUFFMANN, CHRISTIAAN N92-14437
KAYE, JACK A. N92-14538
N92-14547
KAZMIN, VYACHESLAV N92-14103
KEAT, J. N92-14078
KEEFER, CHRISTOPHER W. N92-14837
KEENAN, JAMES A. N92-13996
KEICHER, D. M. N92-14188
KELBEL, D. N92-14083
KELEMEN, MATEI N92-14379
KELLY, R. J. N92-14015
KELTON, D. N92-14388
KERR, J. N92-14291
KERR, RON W. N92-14030
KESSELRING, PAUL N92-14479
KHAN, GULFAM N92-14131
N92-14132
KHANKHASAEV, M. KH. N92-14834
KHARITONOV, YU. I. N92-14702
KHAVANCHAK, K. N92-14146
KHAVARAN, ABBAS N92-14795
N92-14797
KHAWAJA, Y. N92-14132
KHUON, T. S. N92-14336
KIJIMA, N. N92-14866
KILLION, THOMAS H. N92-14590
KIM, C. N92-14159
KIM, CHAN M. N92-14795
N92-14797
KIM, JHOON N92-14950
KIM, JINHO N92-14100
KIM, K. J. N92-14338
KINCAID, J. M. N92-14297
KING, GALEN B. N92-14133
KING, I. D. N92-14267
KIRDEIKIS, J. N92-13982
KISS, MARK J. N92-14062
KLAASSEN, J. N92-14526
KLAETSCHKE, K. N92-14398
KLEIJWEG, JAN C. M. N92-14444
KLEM, MARK D. N92-14112
KLESOV, V. V. N92-14857
KLIER, K. N92-14138
KLIMENKO, K. G. N92-14886
KLOSTERMAN, DON N92-14457
KLUSKENS, M. S. N92-14257
KNABE, F. N92-14012
KNAPP, J. A. N92-14153
KNITTLE, C. D. N92-14613
KNYAZEV, B. A. N92-14855
N92-14856
KOEHLER, W. N92-14410
KOENIG, G. N92-14424
KOHOLA, PEKKA N92-14192
KOHZAKI, Y. N92-14844
KOLB, GREGORY J. N92-14464
KOLKAILAH, FAYSAL A. N92-14119
KOMERATH, N. M. N92-13995
KONOPLEVA, R. F. N92-14173
KOROLYUK, V. V. N92-14760
KOSHEVAYA, N. A. N92-14829
KOSKINEN, KARI N92-14192
KOSTENKO, B. F. N92-14707
N92-14887
KOSTENKO, V. I. N92-14102
KOSTUK, RAYMOND K. N92-14913
N92-14914
KOTELNIKOV, G. A. N92-14710
KOURI, JEFFREY VICTOR N92-14116
KOVTYUKH, A. S. N92-14849
KPONOU, A. E. N92-14799
KRAFT, R. E. N92-14783
KRAMER, R. D. N92-14106
KRAULAND, KONRAD L. N92-14059
KRAUS, ROBERT N92-14294
KRAUT, E. A. N92-14278
KRAVITZ, S. H. N92-14378
KREJSA, EUGENE A. N92-14795
N92-14797
KRESS, M. N92-14265
KRISHNAGOPAL, S. N92-14836
KRISHNAMURTHY, ASHOK K. N92-14214
KRIST, KEVIN N92-14473
KROESE, D. P. N92-14750
KROGMANN, UWE K. N92-14674
KROPOTKIN, A. P. N92-14952
KRZHIZHANOVSKIJ, E. R. N92-14857
KUBRYNSKI, KRZYSZTOF N92-13948
KUHLMAN, JOHN M. N92-13996
KUIJPER, M. N92-14748
KUMAR, R. A. N92-14862
KUMAR, V. K. N92-14079
N92-14080
KUNDE, V. G. N92-14502
KUNDE, VIGIL G. N92-14505
KUNGUROV, F. R. N92-14874
KUNKEL, W. B. N92-14341
N92-14815
KUSTAS, F. M. N92-14153
KUTSCHERA, M. N92-14947
KUZHEVSKIJ, B. M. N92-14960
KUZMIN, YU. V. N92-14816
KUZMINA, N. M. N92-14816
KWAST, KAREN L. N92-14621
N92-14722
KWATRA, S. C. N92-14213
KWON, J. N92-14308
KYRALA, G. A. N92-14339

L

LABRECHE, L. N92-14023
LABRUJERE, TH. E. N92-13929
LACHMANN, E. N92-14406
N92-14422
LACROIX, J. P. N92-14051
LAHTINEN, JOUKO N92-14141
LAI, D. N92-14900
LAKE, MAX L. N92-14170
LAMICH, DAVID J. N92-14539
LANDIS, GEOFFREY A. N92-14111
LANG, K. W. N92-14369
LANGERAK, ROM N92-14620
N92-14635
LANGLOIS, M. N92-13976
LARIONOV, A. V. N92-14833
LAROCCA, FRANCESCO N92-13956
LASKY, F. P. R. N92-14288
LASLETT, L. J. N92-14778
LAURENDEAU, NORMAND M. N92-14133
LAURIN, D. N92-13980
LAVIRON, M. N92-14043
LEE-KWEN, ADRIAN N92-14032
LEE, DAVID D. N92-14223
LEE, JA H. N92-14468
LEE, JINHO N92-14298
LEE, R. N92-14784
LEE, T. N92-14072
N92-14083
LEEMEIJER, G. B. N92-14634
LEES, A. J. N92-14130
LENAKOS, J. N92-13995
LENZ, T. G. N92-14129
LEONARD, DESIREE M. N92-14598
LEONARD, O. N92-13952
LEONOV, V. M. N92-14847
N92-14848
LEPAPE, MARIE-CLAIRE N92-13938
LEPPAENEN, JUHA N92-14192
LEPSHOKOV, S. N. N92-14701

LETZRING, S. A. N92-14330
LEUER, J. N92-14852
LEUNG, K. N. N92-14341
N92-14815
LEUNG, P. S. N92-14371
LEVINE, R. Y. N92-14336
LEVY, MOSHE N92-14475
LEVY, RALPH N92-13959
N92-13972
LEVY, S. C. N92-14293
LI, C. Y. N92-14341
N92-14815
LI, CHAOJUN N92-13970
LI, LIFENG N92-14915
LI, MING N92-14754
LI, SHUANHU N92-14324
LIE, J. N92-14661
LIE, Y. S. N92-14224
LIEBE, DETLEF N92-14382
LILIENTAL-WEBER, Z. N92-14872
LIMA, A. F. N92-14868
LIN, C. S. N92-14323
LIN, J. T. N92-13937
LIN, RENG RONG N92-14365
LIN, SHU N92-14233
LINDSEY, T. F. N92-14157
LINDSTROM, TIMOTHY E. N92-14793
LINK, HAL N92-14452
LIOU, S. G. N92-13995
LIU, C. T. N92-14145
LIU, GAO-LIAN N92-13939
N92-13953
LIU, JANN-YENQ GIM N92-14495
LIU, K. N92-13980
N92-14073
LIU, MAX M.-K. N92-14916
LIU, ZHENYUAN N92-14840
LOCK, G. D. N92-13985
LOEBNER, EGON E. N92-14697
LOEHNBERG, P. N92-14692
LOEWENSTEIN, MAX N92-14511
LOGUNOV, A. A. N92-14884
N92-14885
LONG, A. C. N92-14072
LONG, DEAN J. N92-14685
LOOTSMA, F. A. N92-14758
LOPEZPUMAREGA, M. I. N92-14796
LOPUHAAE, HENDRIK P. N92-14757
LOUBRIEL, G. M. N92-14884
LOUIE, MING N92-14206
LOWE, J. D. N92-13977
LU, SONGYUAN N92-14347
LUCEY, G. K. N92-14189
LUCOT, JAMES B. N92-14586
LUDWIG, GARY L. N92-14047
LUECKEN, D. J. N92-14492
LUK, TING SHAN N92-14343
LUNEV, F. A. N92-14706
LUONGO, RENEE N92-14034
LUU, T. S. N92-13940
LYDA, STEPHEN F. N92-14040
LYNCH, NANCY N92-14254
LYND, L. R. N92-14185
LYONS, P. B. N92-14841
LYSENKO, S. E. N92-14848
LYTLE, FRED E. N92-14133

M

MACNEIL, MALCOLM N92-14016
MADNIA, K. N92-14305
MAGOTRA, N. N92-14613
MAGUIRE, W. C. N92-14502
MAHER, M. N92-14071
MAHIOUT, AMAR N92-14195
MAHRENHOLZ, B. G. N92-14331
MAIER, A. N92-14411
MAILLETTE, J. N92-13985
MAITAN, JACEK N92-14209
MAJJIGI, R. K. N92-14784
MALONE, J. B. N92-13932
MANNING, PAUL E. N92-14020
MANSOUR, Y. N92-14610
MANSOUR, YISHAY N92-14254
MANSURIPUR, M. N92-14903
N92-14904
N92-14905
N92-14906
N92-14907
N92-14908
MAPLES, CHARLES L. N92-14040
MARABITO, MARK N92-14170
MARGOLIS, J. S. N92-14531
MARHEFKA, R. J. N92-14262
N92-14263
MARINO, R. N92-14752
MARKIN, ROBERT E. N92-13934
MARKLEY, F. L. N92-14092
MARKOPOULOS, N. N92-14066
MARLOWE, THOMAS J. N92-14665
MARSHAKOV, A. N92-14704
MARTIN, RODERICK H. N92-14432
MARTINEZ-SANCHEZ, M. N92-14355
MASSIE, S. T. N92-14502
MATOUSEK, S. E. N92-14249
MATTHEWS, W. A. N92-14506
MATUSIAK, JERZY N92-14200
MAUGHMER, MARK D. N92-13999
MAYER, RICHARD J. N92-14899
MBELEDOGWU, I. N92-14337
MCANULTY, D. M. N92-14597
MCCAFFREY, ROBERT R. N92-14169
MCCLOSKEY, T. N92-14362
MCCORMICK, M. PATRICK N92-14519
MCDANELS, DAVID L. N92-14120
MCDIARMID, C. N92-14744
MCELIECE, R. J. N92-14243
MCELROY, CHARLES T. N92-14506
MCEWEN, K. F. N92-13980
MCFAWN, LESTER N92-14058
MCGEE, THOMAS J. N92-14500
N92-14507
N92-14528
MCGLAUN, J. M. N92-14612
MCKENNA, D. L. N92-14541
MCKENZIE, A. J. N92-14345
MCKINNEY, W. D. N92-13977
MCKISSOCK, BARBARA I. N92-14485
MCLANE, P. J. N92-14030
MCLAUGHLIN, D. L. N92-14864
MCLEAN, DAVID R. N92-14700
MCNICE, TERRY N92-14564
MCOMBER, R. N92-14205
MCPETERS, RICHARD D. N92-14549
MCPHERSON, A. N92-14343
MCQUISTON, BARBARA K. N92-14064
MCTAVISH, D. J. N92-13988
MEASURES, R. M. N92-13980
MEDVICK, P. A. N92-14901
MEHDIZADEH, E. N92-14342
MEHOS, MARK S. N92-14454
MEIJER, H. G. N92-14737
MEJIA, CARLOS E. N92-13946
MELNIKOV, P. I. N92-14855
N92-14856
MELTON, ROY N92-14660
MENG, GUANG N92-14350
MENON, P. K. A. N92-14036
MENTALL, JAMES E. N92-14504
N92-14522
MENZEL, CHRISTOPHER P. N92-14899
MERCANTI, ENRICO P. N92-14490
MERRILL, JOHN T. N92-14572
MESTVIRISHVILI, M. A. N92-14884
N92-14885
MEYER, H.-J. N92-14431
MEYER, W. J. N92-14378
MEYZAUD, I. N92-14426
MIAO, YONGMIAO N92-13968
MICHAEL, J. R. N92-14159
MICHAELS, JOHN F. N92-14021
MICHELS, JAMES H. N92-14255
MIKHEEV, ANDREW G. N92-13971
MIKIC, ZORAN N92-14957
MIKULSKI, BARBARA N92-14920
N92-14924
MILES, COE F. N92-14668
MILES, THOMAS N92-14545
MILEY, G. H. N92-14844
MILITELLO, CARMELLO N92-14383
MILITELLO, CARMELO N92-14393
MILLER, EDWARD F. N92-14953
MILLER, JAMES E. N92-14144
MILLER, P. A. N92-14863
MILLER, R. G. N92-14396
MILLER, S. N92-14229
MILLER, TIMOTHY L. N92-14544
MILLER, WAYNE OWEN N92-13994
MILLS, K. C. N92-14167
MILLSAPS, K. T. N92-14355
MILSTER, T. D. N92-14909
N92-14910
N92-14911
N92-14912
MINAEV, V. P. N92-14160
MISHIN, V. P. N92-14068
MISRA, M. S. N92-14153
MISTRETTA, G. D. N92-14075
N92-14083
MITAL, SUBODH K. N92-14122
MITIDIERI, E. N92-14734
MIXSON, JOHN S. N92-14785
MIZIOLEK, A. W. N92-14334
MIZUGAI, Y. N92-14526
MNISZEWSKI, S. M. N92-14901
MODI, V. N92-13957
MOHNEN, V. A. N92-14487
MOINUDDIN, ALIA N92-14170
MOLDER, S. N92-13983
MOLENKAMP, J. H. J. N92-14720
MOLIAN, ARUL N92-14276
MOLIAN, P. N92-14276
MOLINARI, L. N92-14705
MOMOTA, H. N92-14844
MONTAGUE, G. N92-14365
MONTE, PAUL A. N92-14206
MONTGOMERY, EDWARD E. N92-14591
MOOK, D. JOSEPH N92-14094
MOORE, D. N92-14380
MORENCY, ROGER N92-14839
MORGAN, D. R. N92-14058
MORING, ILKKA N92-14199
MORISON, W. D. N92-13984
MOROZOV, A. N92-14704
MORRIS, J. W., JR. N92-14150
N92-14159
N92-14189
MORTARA, K. N92-13999
MOTSINGER, R. E. N92-14783
MOUBARAK, MICHEL N92-14584
MOULIK, A. N92-14900
MOYA, L. M. N92-14288
MOZZHUKHINA, A. R. N92-14952
MUELLER, F. N92-14404
N92-14426
MUELLER, K. T. N92-14808
MUIR, P. F. N92-14687
MUKHOVATOV, V. N92-14851
MULANSKY, BERND N92-14616
N92-14719
MULDERS, M. A. N92-14443
MUNOZ, HERMOGENES R. N92-14385
MUPPALA, JOGESH K. N92-14639
MUR, V. D. N92-14882
N92-14883
MURAKAMI, HIDEAKI N92-14348
MURCRAY, DAVID G. N92-14501
N92-14506
N92-14532
MURCRAY, FRANK J. N92-14501
N92-14506
N92-14532
MURFIN, A. J. N92-14023
MURIO, DIEGO A. N92-13945
N92-13946
MURPHY, BRIAN T. N92-14359
N92-14368
N92-14369
MURPHY, W. P. N92-14162
MURTHY, PAPPU L. N. N92-14118
MURTOVIITA, ESKO N92-14192
MURTY, H. N92-13977
N92-13979
MUSZYNSKA, AGNES N92-14367
N92-14370
MYERS, IRA T. N92-14294

N

NACCARATO, F. N92-13987
NAIN, P. N92-14698
NAKAMURA, YOSIO N92-14949
NANSTAD, R. K. N92-14154
NARAYAN, J. N92-14462
NAVA, D. F. N92-14525
NAWIJN, W. M. N92-14615
NEAMTU, MARIAN N92-14713
N92-14716
NECHAEV, O. YU. N92-14960
NEIDHARDT, H. N92-14888
NELSON, SCOTT A. N92-14110
NELSON, T. N92-13979
NEMESURE, M. N92-14071
NESIC, D. N92-14825
NEWELL, JAMES F. N92-14435
NEWMAN, E. H. N92-14257
NEWMAN, PAUL A. N92-14539
N92-14542
N92-14546
NG, KAM W. N92-14258
NGUYEN, PHUC N92-14309
NGUYEN, RICHARD N92-14279
NIELSEN, J. ERIC N92-14538
NIELSEN, T. N92-14425
NIEMEGEERS, IGNAS G. N92-14266
NIJENHUIS, WILLEM EVERT N92-14642

NIJMEIJER, H. N92-14688
N92-14692
N92-14724
NIR, M. M. N92-14125
NISHIO, S. N92-14852
NISSON, ELVEN H. N92-14019
NITSOPOULOS, IOANNIS N92-14382
NJAU, E. C. N92-14259
N92-14486
N92-14556
N92-14567
N92-14568
N92-14569
NOAH, SHERIF T. N92-14344
NOEL, B. W. N92-14332
NOLT, IRA G. N92-14503
N92-14530
NOOTEBOOM, P. N92-14634
NORDMANN, R. N92-14356
N92-14360
NORRIS, WILLIAM P. N92-14183
NORTHUP, ROBERT L. N92-14281
NOVAK, J. N92-14389
NOVIKOV, E. N92-14317
NOYES, H. PIERRE N92-14878
NOZIK, ARTHUR J. N92-14448
NULLMEYER, ROBERT T. N92-14589
NUNES, A. C., JR. N92-14380
NUSPL, P. P. N92-14216
N92-14227
NYMAN, P.-O. N92-14691

O

OBERPARLEITER, W. N92-14408
N92-14409
OCHEM, H. N92-14273
ODAM, G. A. M. N92-14007
OHAYON, M. N92-13976
OHI, S. N92-14844
OHNISHI, M. N92-14844
OHRLOFF, N. N92-14421
OKABE, AKIRA N92-14348
OKAL, EMILE A. N92-14949
OLSHANSKIJ, V. V. N92-14859
OMALLEY, M. W. N92-14864
OMSTEAD, T. R. N92-14165
ONEILL, ALAN N92-14545
ONEILL, KEVIN N92-14440
ONO, M. N92-14361
OOSTERLEE, C. W. N92-14321
OPPERMANN, H. N92-14398
ORON, ALEXANDER N92-14322
ORSZAG, S. N92-14788
OSBORN, R. N92-14869
OTAWARA, YASUHIKO N92-14348
OTOSHI, T. Y. N92-14244
N92-14245
OTTENSTEIN, N. A. N92-14072
OVACIK, L. N92-13937
OVERMARS, MARK N92-14747
OZA, D. H. N92-14075

P

PACHECO, JAMES E. N92-14455
PAEZ, T. L. N92-14388
PALAMIDESSI, CATUSCIA N92-14651
N92-14654
PALAZZOLO, A. B. N92-14365
PALMER, S. J. N92-14181
PANASYUK, M. I. N92-14849
N92-14960
PANCHAPAKESAN, N. R. N92-14299
PANCHENKO, V. I. N92-14859
PAPAILIOU, K. D. N92-13942
PARK, J. K. N92-14610
PARK, K. N92-14530
PARK, S. H. N92-14880
PARNES, M. N92-14124
PARRISH, ALAN N92-14508
PASCHAL, WILLIAM A. N92-13998
PASHCHENKO, A. B. N92-14809
PASSCHIER, D. M. N92-14004
PASTERNAK, ALAN D. N92-14456
PATT, F. S. N92-14079
N92-14080
PATTERSON, G. N92-14906
N92-14907
PAUL, D. K. N92-14225
PAYNE, W. A., JR. N92-14525
PEARSON, R., JR. N92-14512
PEART, NOEL A. N92-14786
PECORA, LOUIS M. N92-14376
PEELING, N. E. N92-14624
PEILIANG, XU N92-14576
PERELYGIN, V. P. N92-14942
PEREZ-DAVIS, MARLA E. N92-14485
PERKINS, L. J. N92-14861
PERKINS, M. A. N92-14396
PERRY, G. S. N92-14140
PESCE-RODRIGUEZ, ROSE A. N92-14180
PESCIOTTA, ERIC J. N92-14020
PESTRIKOV, D. N92-14830
PETER, O. N92-14410
N92-14420
PETERS, C. N92-14414
PETERS, DAVID A. N92-14038
PETERSON, ERIK S. N92-14169
PETERSON, M. W. N92-14448
PETRIK, EDWARD J. N92-14212
N92-14215
N92-14218
PETRINI, G. L. N92-13985
PEYTON, GARY R. N92-14450
PFAENDTNER, JAMES W. N92-14539
PFISTER, LEONHARD N92-14515
N92-14551
N92-14552
PFLUGER, P. R. N92-14713
PHILLIPS, ROGER J. N92-14949
PIANESE, C. N92-14328
PICKET, J. S. N92-13985
PICKET, S. N92-13976
PICKETT, H. N92-14531
PIDO, JOHN G. N92-14076
PIETROBON, STEVEN S. N92-14211
PIJPERS, M. N92-14443
PILLSBURY, ALLEN D. N92-14335
PITCHFORD, P. N92-14484
PITTS, J. ROLAND N92-14463
PITTS, RICHARD M. N92-14662
PITTS, WILLIAM C. N92-14098
PIVA, R. N92-14304
PLAKIDA, N. M. N92-14870
PLAKS, KENNETH N92-14937
POBYLITSA, P. V. N92-14806
PODOLSKE, JAMES R. N92-14511
POEPPEL, R. B. N92-14291
POGGIO, TOMASO N92-14683
POHJANNE, PEKKA N92-14195
POKLEMBA, JOHN J. N92-14221
N92-14231
POLEVOJ, A. R. N92-14847
POLLACK, JAMES B. N92-14537
PONTANO, B. A. N92-14225
POOLE, L. R. N92-14541
POOLE, LAMONT R. N92-14519
POPOV, V. S. N92-14882
N92-14883
POPP, P. N92-14418
POSNER, EDWARD C. N92-14237
N92-14248
POST, FRITS H. N92-14650
POST, M. J. N92-14564
POTAPCZUK, MARK G. N92-14001
POTTER, WILLIAM J. N92-14700
POUBANNE, PHILIPPE N92-14168
POWELL, CLEMANS A. N92-14780
POYET, P. N92-14426
POYNTER, R. N92-14531
PRASANTH, RAVI K. N92-13934
PRATHER, MICHAEL N92-14536
PRETEUX, FRANCOISE N92-14584
PRICE, D. L. N92-14161
PRICE, L. N92-14494
PRIESTLEY, K. F. N92-14557
PRINZ, R. N92-14417
PROSSER, WILLIAM H. N92-14790
PRUESS, K. N92-14316
PRZYBYSZEWSKI, J. S. N92-14037
PUESCHEL, R. F. N92-14517
PUGH, C. E. N92-14387
PUGLIESE, V. N92-13987
N92-13988
PUZYNIN, I. V. N92-14708
PUZYNINA, T. P. N92-14708

Q

QIAN, Y. J. N92-13949
QUACH, TAI N92-13981
QUADFASEL, U. N92-14424
QUAY, G. H. N92-14124

R

RADHAKANT, S. N92-14011
RADOMSKI, M. S. N92-14082
RADOSTITZ, J. V. N92-14530
RAE, A. N92-14080
RAITT, W. JOHN N92-14186
RAM, G. R. N92-14029
RAMAMOORTHY, P. A. N92-14669
N92-14670
RAMSEY, CHRISTOPHER N92-14357
N92-14358
RANDELL, G. P. N92-14625
RANGARAJAN, G. N92-14340
RANTANEN, JUKKA N92-14601
RAOVENKATESWARA, K. T. N92-14151
RAPP, HELMUT N92-14054
RAUGH, MICHAEL R. N92-14694
RAZDAN, R. N92-14225
RCHEULISHVILI, G. L. N92-14765
READY, JOHN F. N92-14110
REARDON, KIMBERLY N92-14034
REDINBO, ROBERT N92-14220
REDMAN, W. A. N92-14225
REED, B. N92-14744
REED, RUSSELL, JR. N92-14182
REGISTER, A. N92-14664
REID, L. D. N92-13982
REILLY, H. F., JR. N92-14246
REINLEITNER, LEE A. N92-14943
REITER, MICHAEL N92-14656
REMSBERG, ELLIS E. N92-14545
RENGER, WOLFGANG N92-14571
RESCA, LORENZO N92-14277
RESPONDEK, W. N92-14752
REVERCOMB, H. E. N92-14493
REYN, J. W. N92-14735
REYNOLDS, NATHANIEL D. N92-14544
RHODES, C. K. N92-14343
RICE, E. J. N92-14000
N92-14003
RICE, ROBERT F. N92-14611
RIDDLE, L. N92-14222
RIETDIJK, R. H. N92-14823
RILEY, MICHAEL A. N92-14171
RIM, C. W. N92-13935
RIND, DAVID N92-14543
RINSLAND, CURTIS P. N92-14501
N92-14506
N92-14529
N92-14531
N92-14532
RITCHIE, R. O N92-14164
RITCHIE, R. O. N92-14149
N92-14151
N92-14152
RITCHIE, STEPHEN R. N92-14040
ROBERTS, D. J. N92-14686
ROBINSON, P. A. N92-13982
ROBROEK, L. M. J. N92-14123
ROCKWAY, MARTY R. N92-14589
RODRIGUEZ, ELVIN N92-14114
RODRIGUEZ, JOSE M. N92-14572
ROGERS, DAVID N92-14668
ROGSTAD, D. H. N92-14239
ROISMAN, W. P. N92-13962
N92-13963
ROMANO, R. A. N92-13982
ROMEROFILHO, C. A. N92-14940
ROMIG, A. D., JR. N92-14159
ROOD, RICHARD B. N92-14538
N92-14539
N92-14547
ROSE, D. N. N92-14124
ROSE, WILLIAM C. N92-14313
ROSEN, A. N92-14864
ROSEN, JAMES M. N92-14564
ROSENFELD, A. H. N92-14494
ROSENFIELD, JOAN E. N92-14538
N92-14542
ROSS, JOAN S. N92-14184
ROSZMAN, L. N92-14081
ROTT, D. N92-14413
ROUSSEEUW, PETER J. N92-14647
ROUSSOU, RONALD N92-14645
RUDBACK, N. E. N92-14010
RUDIN, EMILY B. N92-14934
RUGGIERO, JOSEPH W. N92-14020
RUIJGROK, G. J. J. N92-14798
RUIZ, A. C. N92-14724
RUPPERSBERG, GERHARD H. N92-14571
N92-14959
RUSS, S. H. N92-14664
RUSSELL, C. K. N92-14380
RUSSELL, JAMES M., III N92-14503
N92-14545
RUSSELL, PHILIP B. N92-14515
RUSSKIKH, V. N. N92-14807
RUTAN, S. C. N92-14128

RUTH, JOHN C. N92-14049
RUZZANTE, J. E. N92-14796
RYAN, P. M. N92-14265
RYAN, S. G. N92-14108

S

SAARENVIRTA, G. N92-13977
SAARIO, TIMO N92-14194
SABOUNGI, M. L. N92-14161
SADAKOV, S. N92-14852
SADIQ, A. N92-14132
SALANSKY, N. N92-13984
SALEEB, A. F. N92-14434
SALLABERGER, C. N92-13987
SAMII, M. V. N92-14072
N92-14074
N92-14083
SANANDRES, LUIS A. N92-14352
N92-14353
N92-14372
N92-14373
SANETRA, C. N92-14401
SANFELIZ, JOSE G. N92-14118
SARAZIN, CRAIG L. N92-14944
SARTORY, W. K. N92-14332
SARYCHEVA, L. I. N92-14817
SATO, K. N92-14844
SAVELEV, M. V. N92-14709
SAVU, G. N92-13931
SAYEGH, S. N92-14221
SAZHINA, G. P. N92-14961
SCHAAP-KRUSEMAN, JOOS N92-14618
SCHAEFER, R. N92-14402
SCHAFF, JAMES M. N92-14040
SCHANZLE, A. F. N92-14074
SCHAPPERT, G. T. N92-14339
SCHARRER, G. L. N92-14288
SCHARRER, JOSEPH K. N92-14359
N92-14368
SCHAUBERT, DANIEL H. N92-14261
SCHELLINX, HAROLD N92-14740
SCHEPERS, WIM N92-14618
SCHIEBER, B. N92-14610
SCHIJVE, J. N92-14045
SCHIPPER, J. D. N92-14296
SCHLEGELMILCH, RICHARD F. N92-14212
N92-14215
SCHMAELZLE, U. N92-14428
SCHMIDLIN, FRANCIS J. N92-14523
SCHMIDT, E. N92-13950
SCHMIDT, V. N92-14750
SCHOEBERL, MARK R. N92-14542
N92-14546
SCHOEPFEL, A. N92-14397
N92-14410
SCHOT, JEROEN N92-14600
N92-14636
N92-14638
SCHRIJVER, A. N92-14744
SCHROCK, R. R. N92-14113
SCHULER, JAMES J. N92-14392
N92-14436
SCHULTZ, W. N92-14306
SCHUMACHER, J. M. N92-14748
SCHUNK, ROBERT W. N92-14186
N92-14955
SCHUT, C. P. N92-14741
SCHWANTES, S. N92-14423
SCHWARMANN, L. N92-14431
SCHWARTEN, H. N92-13951
SCOTT, C. D. N92-14185
SEALS, R. K., JR. N92-14553
SEALS, ROBERT K., JR. N92-14532
SEEGER, T. N92-14427
SEGALLIS, G. P. N92-14230
SEIDELMANN, P. K. N92-14086
SELIGMAN, H. N92-14820
SELLO, INES N92-14719
SENESH, D. N92-14146
SENNETT, C. T. N92-14625
SERAN, H. C. N92-14216
SERE, KAISA N92-14271
SERGEEV, A. V. N92-14882
N92-14883
SERRA, J. N92-14743
SESSLER, A. M. N92-14338
N92-14340
SHABALIN, A. L. N92-14828
SHABANOV, S. V. N92-14890
SHAHIDI, ANOOSH K. N92-14212
SHAHSHAHANI, M. N92-14240
SHAIKH, M. A. N92-14158
SHALKHAUSER, MARY JO N92-14204
SHAMAEV, ALEKSEY S. N92-13971
SHAMIR, Y. N92-14880
SHANNON, J. D. N92-14489
SHARF, I. N92-13987
SHARP, W. M. N92-14340
SHAVOKHINA, N. S. N92-14889
SHAVRIN, P. I. N92-14960
SHAW, S. J. N92-14140
SHCHEGOLEV, V. A. N92-14146
SHEFFER, SCOTT G. N92-13954
SHEKELL, TED K. N92-14791
SHEN, J. Z. N92-13983
SHEN, MO-HOW HERMAN N92-13936
SHEN, Y. R. N92-14135
SHENG, B. C. N92-14361
SHENG, Y. N92-13978
N92-13983
SHEPHERD, B. N92-14744
SHERRY, MICHAEL A. N92-14232
SHI, YUN YUAN N92-14095
SHIMP, ALAN G. N92-14281
SHINN, J. H. N92-14488
SHLYAPNIKOV, P. V. N92-14805
SHOAIB, K. A. N92-14158
SHORT, A. N92-13983
SHUBIN, G. R. N92-13933
SHUSTER, MALCOLM D. N92-14077
SHUVALOV, R. S. N92-14286
SHYY, DONG-JYE N92-14203
N92-14208
SIEMANN, R. N92-14836
SILVA, DAVID RICHARD N92-14938
SIMPSON, PATRICK K. N92-14675
N92-14681
SIMPSON, R. L. N92-14312
SIMS, A. J. N92-14099
SINCARSIN, G. B. N92-13987
N92-13988
SINEV, N. B. N92-14817
SINGH, K. ROMI N92-14025
SINGH, RAJIV K. N92-14462
SISLIAN, J. P. N92-13978
N92-13983
SKOE, IVAR HELGE N92-13943
SMIALEK, JAMES L. N92-14179
SMID, H. D. N92-14893
SMIRNOV, A. P. N92-14848
SMIRNOV, YU. F. N92-14702
SMITH, A. V. N92-14842
SMITH, ALEX E. N92-14013
SMITH, I. G. N92-14029
SMITH, JAMES E. N92-14958
SMITH, MARY ANN H. N92-14529
N92-14531
N92-14532
SMITH, PAUL N92-14626
SMREKAR, SUZANNE ELIZABETH N92-14948
SNEEUW, N. J. N92-14115
SNETSINGER, K. G. N92-14517
SNOEYINK, JACK N92-14747
N92-14769
SNYDER, J. N92-14221
SOBIECZKY, H. N92-13949
SOKOLOV, S. N. N92-14558
SOKOLSKAYA, N. V. N92-14961
SOLOMON, G. N92-14243
SOLOMON, S. N92-14541
SOLOMON, SEAN C. N92-14949
SOLOMON, SUSAN N92-14503
SOMMERHALDER, R. N92-14644
SOMORJAI, G. A. N92-14136
SONG, M. N92-14308
SONSINO, C. M. N92-14403
N92-14404
N92-14405
N92-14426
SOOSAAR, R. J. N92-13982
SORENSEN, THOMAS N92-13960
SORNBORGER, A. N92-14825
SOWIZRAL, HENRY A. N92-14894
SPAAN, EDITH N92-14721
N92-14723
SPARROW, VICTOR W. N92-14792
SPEARS, L. T. N92-14106
SPEARS, W. R. N92-14861
SPEKREIJSE, S. P. N92-14325
N92-14326
SPENCER, M. N92-14526
N92-14527
SPILLARD, CANDIDA N92-14201
SPINELLI, JOHN N92-14254
SRINIVANSAN, K. N92-14117
STABILE, P. J. N92-14864
STAMENKOVIC, S. N92-14870
STANLEY, J. T. N92-14463
STANTON, P. H. N92-14246
STARR, W. L. N92-14512
STARRENBURG, JACOB N92-14379
STARSON, SCOTT N92-14878
STARZEL-DEHEL, BARBARA N92-14034
STASSEN, H. N92-13983
STAUFFER, DONALD R. N92-14110
STEBER, M. N92-14221
STECHEL, E. B. N92-14137
STEFFEN, A. A. N92-14164
STEINFELD, J. I. N92-14526
STEINHAUER, L. C. N92-14844
STENGLE, THOMAS N92-14070
STEPHAN, AMY N92-14217
STETSENKO, S. G. N92-14942
STETTER, H. N92-14354
STEVENS, C. M. N92-14491
STEVENSON, THOMAS ROBERT N92-14497
STEWART, S. R. N92-14244
STIEF, L. J. N92-14525
STOLARSKI, RICHARD S. N92-14534
N92-14538
N92-14542
N92-14547
STONE, MARK L. N92-14169
STORACE, ALBERT F. N92-14364
STOREY, C. N92-14605
STORM, D. W. N92-14814
STOYENKO, ALEXANDER D. N92-14665
STRACHAN, RUSSELL L. N92-14087
STRAHAN, SUSAN E. N92-14511
STRAUS, A. N92-14796
STRAUSSFOGEL, DENNIS M. N92-13999
STRELTSOV, V. N. N92-14260
N92-14810
N92-14811
STRENG, MARTIN N92-14715
STRY, GRESELDA I. N92-14094
STUELPNAGEL, JOHN C. N92-14057
STUERCHLER, R. N92-14362
STUMP, N. A. N92-14804
STURRUS, RICHARD A. N92-14266
STUTZIN, G. C. N92-14815
SUGIHARA, RYO N92-14843
SULLA, JEFFREY L. N92-14394
SULLIVAN, P. A. N92-13979
N92-13983
SUNDARAM, P. N92-14310
SUNG, C.-H. N92-13957
SUNWOO, A. J. N92-14189
SUPERFINE, R. N92-14135
SUSHKOV, V. V. N92-14286
SUSKI, HARALD N92-14382
SUTIJA, D. P. N92-14290
SUTTON, ROBERT F. N92-14368
SWANSON, R. C. N92-13932
SWERTZ, O. C. N92-14441
SYKES, J. E. H. N92-14349
SYMONDS, D. E. N92-14628
SYMONS, T. M. N92-14942
SYMS, RAYMOND A. N92-14033
SZCZUREK, A. N92-14835

T

TAFF, L. G. N92-14089
TAGHAVI, R. N92-14000
TAGUE, JOHN N92-14235
TAKANASHI, SUSUMU N92-13930
TALLO, DONALD N92-14218
TAN, WEI S. N92-14661
N92-14663
N92-14664
TANAKA, M. N92-14872
TANG, FANGQUN N92-14854
TARASOV, V. N. N92-14749
TAYLOR, A. D. N92-14869
TAYLOR, A. J. N92-14339
TAYLOR, JOHN A. N92-14335
TEEUW, WOUTER B. N92-14633
TEEUWEN, J. H. N92-14444
TEL, GERARD N92-14667
TELEGIN, V. I. N92-14874
TELES, J. N92-14071
TEMME, N. M. N92-14759
TENBERG, A. J. W. M. N92-14619
TENNYSON, R. C. N92-13984
N92-13989
TERENTYEV, M. V. N92-14559
TERIAUCHI, M. N92-14872
TERRY, P. F. N92-14627
THIELEKE, G. N92-14354
THOMAS, GARY N92-14540
THOMAS, GARY S. N92-14067
THOMAS, J. N92-14221
THOMPSON, A. M. N92-14534
THOMPSON, JOE F. N92-14607

THURMAN, S. W. N92-14249
TIDJANI, M. N92-14867
TITCOMBE, M. N92-13976
TIWARI, S. N. N92-14117
TOBIN, K. W. N92-14332
TODO, A. S. N92-14819
TOLSTOJ, V. N. N92-14702
TOMITA, Y. N92-14844
TOMLINSON, CHRISTEL I. N92-14685
TOMLINSON, S. N92-14008
TOON, BRIAN N92-14516
TOON, OWEN B. N92-14521
N92-14537
N92-14540
TORGOVITSKY, S. N92-14096
TORRES, ARNOLD L. N92-14524
TORTORELLI, DANIEL A. N92-13944
TOTH, R. N92-14531
TOUPIN, T. N92-14418
TOWSLEY, D. N92-14698
TRACY, ED N92-14463
TREPTAU, J. P. N92-14909
N92-14910
N92-14911
TRETMANS, JAN N92-14753
TRIFU, O. N92-13931
TRIVEDI, KISHOR S. N92-14639
TROELSTRA, A. S. N92-14599
TROMP, JOHN N92-14623
TROYER, G. L. N92-14803
TRUSCOTT, P. R. N92-14099
TRUSTY, R. M. N92-14912
TRYGGVASON, G. N92-14308
TSAKANYAN, O. S. N92-14829
TSANG, WING N92-14458
TSENG, C. T. N92-14150
TUCHMAN, ALAN N92-14700
TUCK, ADRIAN N92-14516
TUDES, BULENT N92-14060
TURCHI, CRAIG S. N92-14449
TURCO, RICHARD N92-14540
TURLEY, W. D. N92-14332
TURNER, J. A. N92-14448
TURNER, R. N92-13980
TURNER, R. E. N92-14535
TURNER, S. N92-14652
TURTON, JOHN A. N92-14052
TUSKA, EVELYN B. N92-14954
TYPPI, VAEINOE N92-14192

U

UBONG, E. U. N92-14142
UGOLETTI, ROBERTO M. N92-14394
UHLMANN, DONALD R. N92-14172
ULAN, R. N92-14011
ULBRICH, HEINZ N92-14363
ULLRICH, RANDY R. N92-14685
UNDERWOOD, HAROLD W. N92-14056
UNGER, W. J. N92-13989

V

VAELTTILAE, JAAKKO N92-14197
VAJINGORTIN, L. D. N92-13962
N92-13963
VALERO, F. P. J. N92-14527
VALERO, FRANCISCO P. J. N92-14514
VALIS, T. N92-13980
VANCE, J. M. N92-14352
N92-14353
VANDAMME, RUUD N92-14715
N92-14718
VANDENAKKER, BERT R. M. N92-14640
VANDENBRAEMBUSSCHE, R. A. N92-13952
VANDENNEHEUVEL, SIEGER N92-14621
VANDERAAR, MARK N92-14235
VANDERLEEUW, J. N92-14644
VANDERMAST, CHARLES N92-14601
N92-14648
VANDERSCHAFT, A. J. N92-14689
N92-14690
N92-14752
VANDERWEGEN, L. L. M. N92-14688
VANDEWETERING, BRIAN L. N92-14685
VANEIJK, PETER N92-14636
VANHOLTEN, J. W. N92-14822
VANHULZEN, J. A. N92-14720
VANKLEIJ, REINIER N92-14645
VANKREVELD, MARC N92-14769
VANLEEUWEN, JAN N92-14745
N92-14762
VANLEHN, KIRT N92-14684
VANLIESHOUT, M. N. M. N92-14763
VANOMMEREN, J. C. W. N92-14751
VANPAASSEN, D. M. N92-14798
VANRIJN, A. M. C. N92-14644
VANSCHAIK, P. N92-14632
VANSINDEREN, MARTEN N92-14600
VANWALSUM, THEO N92-14650
VANZOMEREN, BERT C. N92-14647
VARDANYAN, I. N. N92-14817
VAREKA, W. N92-14866
VARKOVITSKAYA, A. YA. N92-14961
VAUGHAN, J. D. N92-14129
VAWTER, G. A. N92-14378
VEDDER, JAMES F. N92-14512
N92-14513
VEIDENBAUM, A. N92-14652
VENIS, A. C. J. N92-14325
N92-14326
VENKATARAMAN, R. N92-14080
VENKATESWARARAO, K. T. N92-14149
N92-14152
VERBRUGGE, RINEKE N92-14738
VERHAARD, LOUIS N92-14753
VERHOEF, W. N92-14442
VERMA, S. N92-14517
VERMEER, J. N92-14767
VERNUCCI, A. N92-14226
VERSHIK, A. M. N92-14709
VERSLOOT, JACK N92-14650
VERWEIJ, A. N92-14893
VIANCO, P. T. N92-14188
VICKERS, MARYANN N92-14017
VIITANEN, PASI N92-14198
VINEY, B. N92-13940
VITANYI, PAUL M. B. N92-14623
N92-14754
VOELCKERS, U. N92-14027
VOIT, F. J. N92-14275
VOKITS, RONALD S. N92-14055
VOLNA, WILLIAM M. N92-14110
VOLODICHEV, N. N. N92-14960
VSEVOLOZHSKAYA, T. A. N92-14832

W

WACHTEL, STEPHEN R. N92-14657
N92-14658
N92-14659
WAHLIN, E. K. N92-14339
WALDROP, J. R. N92-14278
WALLECZEK, J. N92-14583
WALLEY, S. M. N92-14181
WALSH, C. N92-13979
WALTER, H. N92-14429
WALTER, W. R. N92-14557
WALTERS, JERRY L. N92-14212
WANG, M. S. N92-14909
N92-14912
WANG, R. T. N92-14238
WANG, SHANGBING N92-14854
WANGLER, T. P. N92-14826
WARD, MICHAEL J. N92-14837
WATSON, J. M. N92-14341
WEAVER, M. J. N92-14282
WEBB, B. J. N92-14174
WEBER, F. N92-14941
WEERTMAN, J. R. N92-14162
WEGENER, STEVE N92-14516
WEI, BAOSUO N92-13970
WEI, R. N92-14153
WEINBERG, A. N92-14205
WEINSHALL, DAPHNA N92-14587
WEIR, BENNETT N92-14295
WEISER, P. N92-14356
N92-14360
WELDON, ROGER B. N92-14565
WELLMAN, DENNIS L. N92-14564
WELSTEAD, STEPHEN T. N92-14837
WELTER, GARY L. N92-14090
WERNLUND, J. V. N92-14230
WESSELING, P. N92-14321
WHITAKER, KEVIN W. N92-13934
WICKLUND, A. B. N92-14800
WIEDEMAN, R. N92-14206
WIEDEMANN, RANDAL A. N92-14033
WIEDER, H. H. N92-14283
WIJSHOFF, H. N92-14603
N92-14652
WILBUR, P. J. N92-14153
WILBY, JOHN F. N92-14785
WILHOITE, S. N92-14008
WILKINSON, T. S. N92-14371
WILLE, L. T. N92-14867
N92-14873
WILLIAMS, R. K. N92-14332
WILLMARTH, W. N92-14305
WINGLEE, ROBERT M. N92-14846
WINKLER, P. N92-14573
WINSTON, ROLAND N92-14466
WISEMAN, SIMON N92-14630
N92-14917
WITTEVEEN, CEES N92-14641
N92-14642
WOJCIK, W. N92-14947
WOLF, KLAUS N92-14382
WOLVERTON, C. N92-14147
WOLZ, DIETMAR N92-14637
WON, JOHN N92-14394
WONG, C. H. N92-13985
WOO, K. T. N92-14223
WOOD, RICHARD J. N92-14210
WOODCOCK, B. N92-13977
WOODS, MICHAEL B. N92-14662
WOODS, PETER N92-14506
WOOLET, STEVEN P. N92-14639
WORKMAN, GARY L. N92-14134
WRIGHT, E. L. N92-14079
N92-14080
WRIGHT, W. A. N92-14680
WU, LIYI N92-13969
WU, TE-HO N92-14903
WURTELE, J. S. N92-14850

X

XIA, ZHIXUN N92-13969
XIANG, X. N92-14866
XIAOFENG, GUO N92-14727
XUELIANG, LI N92-14711
N92-14726
N92-14727
N92-14728
N92-14729

Y

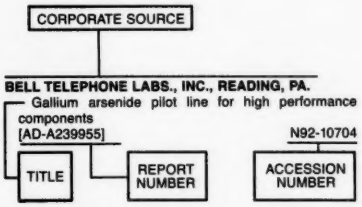
YAMAMOTO, S. N92-14851
YAMANAKA, KAORU N92-14843
YANG, C.-I. N92-14310
YARDLEY, JAMES T. N92-14471
YARRINGTON, L. N92-14104
YASTROP, GLORIA N92-14034
YATES, JOHN E. N92-13997
YEE, C. N92-14083
YIN, YI-YIAN N92-14842
YNGVESSON, K. SIGFRID N92-14261
YOSHIKAWA, K. N92-14844
YOUNG, A. T. N92-14341
N92-14815
YOUNG, D. H. N92-14095
YOUNG, KIM N92-14564
YOUNG, RICHARD E. N92-14537
YUE, D. N92-14311

Z

ZAAL, K. J. J. M. N92-14044
ZAJTSEV, F. S. N92-14848
ZAJTSEV, S. L. N92-14177
ZAKHARIEV, B. N. N92-14708
ZALLER, MICHELLE M. N92-14112
ZAMAN, K. B. M. Q. N92-14003
ZAMBELLA, DOMENICO N92-14739
ZAMCHALOVA, E. A. N92-14961
ZAMIRALOV, V. S. N92-14701
ZANTEMA, H. N92-14653
ZATSEPIN, V. I. N92-14961
ZAVITSANOS, PETER D. N92-14171
ZEFF, JACK D. N92-14451
ZEGELING, ANDRE N92-14732
ZELLER, R. T. N92-14825
ZENNER, H. N92-14401
N92-14430
ZEPP, RICHARD G. N92-14446
ZETTL, A. N92-14866
ZHANG, D.-L. N92-13986
ZHANG, MOUJIN N92-13968
ZHANG, YAN N92-14879
ZHAO, FENG N92-14384
ZHENG, X. N92-14303
ZHOU, FENG LEI N92-14904
ZHOU, YONGZHENG N92-14854
ZHOU, ZHENQUAN N92-14302
ZHU, ZIQIANG N92-13969
ZIMMERMAN, G. A. N92-14250
N92-14251
ZIMMERMAN, PATRICK L. N92-14076
ZIMMERMAN, T. N92-14287
ZINGG, D. W. N92-13977
N92-13979

ZINOVEV, A. N. N92-14857
ZUTAVERN, F. J. N92-14864

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES (USSR), PERM.
Optimal interaction of indenter with inhomogeneous plate N92-13964
Analysis of the optimal laminated target made up of discrete set of materials N92-13965

ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, KHARKOV.
Quasi-analogue method for determination thermal contact resistance
[DE91-638960] N92-14829
Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field
[DE91-623737] N92-14859

ACADEMY OF SCIENCES (USSR), LENINGRAD.
Critical behaviour of Y-Ba-Cu-O HTSC-ceramics under irradiation by reactor neutrons
[DE91-636999] N92-14173
The low field electrodynamics of HTSC
[DE91-637000] N92-14285
Method of the projection operators and q-analog of the quantum angular momentum theory. 1: Clebsch-Gordan coefficients and irreducible tensor operators
[DE91-635999] N92-14702
Quarks in the instanton vacuum. 1: Quark propagator
[DE91-637129] N92-14806

ACADEMY OF SCIENCES (USSR), MOSCOW.
Inverse problems in diffraction N92-13971
Quark-biquark baryon structure: Leptonic decay of baryons in QCD and in unitary symmetry
[DE91-634556] N92-14701
Ionic composition of plasma and energetic particles in the near-earth cosmic space
[DE91-638486] N92-14849

ACADEMY OF SCIENCES (USSR), NOVOSIBIRSK.
Scaling properties of band random matrices
[DE91-635977] N92-14705
Program complex for problems of atomic physics, part 3
[DE91-636263] N92-14812
Electrohydrodynamic emitters of ion beams
[DE91-636293] N92-14828
Nonlinear coherent beam-beam oscillations in the rigid bunch model
[DE91-639001] N92-14830
Dynamical chaos and beam-beam models
[DE91-639002] N92-14831
Radiative increase of beam emittance in the final lense of a linear collider
[DE91-639003] N92-14832
Program for numerical simulation of non-axially symmetrical electron beam transport in long channels
[DE91-639062] N92-14833
Characteristics of a plasma produced by magnetic straight discharge in the metal chamber at the SPIN device
[DE91-636499] N92-14855
Interaction of the high-power microsecond REB with gas and plasma in a 1-m solenoid
[DE91-636500] N92-14856
Determination of plasma density and ion temperature using hydrogen radiation spectral measurements in a gas-dynamic trap
[DE91-636586] N92-14857
Suppression of the Kelvin-Helmholtz instability by plasma jet electric field reversal
[DE91-636636] N92-14858

ADSYSTECH, INC., SILVER SPRING, MD.
General aviation activity and avionics survey, calendar year 1989
[PB91-179234] N92-13926

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
The Conflicting Forces Driving Future Avionics Acquisition
[AGARD-LS-176] N92-14046
Knowledge based system applications for guidance and control
[AGARD-AR-284] N92-14065
Artificial Neural Network Approaches in Guidance and Control
[AGARD-LS-179] N92-14673

AEROCHEM RESEARCH LABS., INC., PRINCETON, NJ.
Direct computation of turbulence and noise
[NASA-CR-187616] N92-14788

AEROJET-GENERAL CORP., SACRAMENTO, CA.
Ceramic regenerator program
[NASA-CR-189053] N92-14374

AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OH.
Evolution of avionic systems architecture, from the 1950's to the present N92-14047
Avionics standardization in the USAF: 1990 to 1990 N92-14048
Common avionics baseline: The product of the joint integrated avionics working group N92-14053
Avionics modernization/upgrades in the late 1990s N92-14055
Avionics reliability, durability, and integrity: Can they be independent of application? N92-14056

AEROSPACE CORP., EL SEGUNDO, CA.
Fine-structure artifact of the velocity distribution of Cs beam tubes as measured by the pulsed microwave power technique
[AD-A241078] N92-14275
The effect of hydrochloric acid pretreatments on 440C steel surface composition and the adhesion and endurance of sputter-deposited MoS2 solid lubricant films
[AD-A241077] N92-14375

AIR FORCE ACADEMY, CO.
Orbit determination error analysis for an interior libration point orbit in the Sun-Earth + Moon elliptic restricted three-body problem
[AD-A241690] N92-14069

AIR FORCE SYSTEMS COMMAND, GRIFFISS AFB, NY.
Multichannel detection using the discrete-time model-based innovations approach
[AD-A241331] N92-14255

AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OH.
China aviation journal (selected article)
[AD-A240985] N92-13990
International aviation (selected article)
[AD-A240986] N92-13991
International aviation (selected article)
[AD-A240987] N92-13992
International aviation (selected articles)
[AD-A241119] N92-13993

AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OH.
Avionics technology beyond 2000 N92-14058

ALABAMA UNIV., HUNTSVILLE.
Spectroscopy and multivariate analyses applications related to solid rocket nozzle bondline
[NASA-CR-189510] N92-14134

ALABAMA UNIV., TUSCALOOSA.
Design of thrust vectoring exhaust nozzles for real-time applications using neural networks N92-13934

ALLIED-SIGNAL AEROSPACE CO., BALTIMORE, MD.
MLS system error model identification and synthesis N92-14015

ALLIED-SIGNAL AEROSPACE CO., KANSAS CITY, MO.
CNC water-jet machining and cutting center
[DE92-000661] N92-14187

ALLIED-SIGNAL CORP., MORRISTOWN, NJ.
Potential industrial applications of photons N92-14471

AMERASIA TECHNOLOGY, INC., WESTLAKE VILLAGE, CA.
Application of convolve-multiply-convolve SAW processor for satellite communications N92-14224

AMERICAN SCIENCE AND ENGINEERING, INC., CAMBRIDGE, MA.
Solar x ray astronomy rocket program
[NASA-CR-183494] N92-14935

AMES LAB., IA.
Development of instrumentation for magnetic nondestructive evaluation
[DE92-000152] N92-14381
Structures and thermodynamics of some rare earth sulfides
[DE91-018554] N92-14879

AMSTERDAM UNIV. (NETHERLANDS).
History of constructivism in the twentieth century
[ITLI-ML-91-05] N92-14599
Weak equivalence for constraint sets
[ITLI-CT-91-05] N92-14621
Levationis Laus
[ITLI-CT-91-08] N92-14622
A randomized algorithm for two-process wait-free test-and-set
[ITLI-CT-91-10] N92-14623
Census techniques on relativized space classes
[ITLI-CT-91-06] N92-14721
The incomplete database
[ITLI-CT-91-07] N92-14722
Quasi-injective reductions
[ITLI-CT-91-11] N92-14723
On the metamathematics of weak theories
[ITLI-ML-91-02] N92-14736
On the proofs of arithmetical completeness for interpretability logic
[ITLI-ML-91-03] N92-14739
Collapsing graph models by preorders
[ITLI-ML-91-04] N92-14740
Combinatorial properties of finite sequences with high Kolomogorov complexity
[ITLI-CT-91-09] N92-14754
The consistency of an extended NaDSet
[ITLI-ML-90-11] N92-14768

ANACAPA SCIENCES, INC., FORT RUCKER, AL.
Human factors research in aircrew performance and training: 1990 annual summary report
[AD-A241134] N92-14597

ANALYTICAL SERVICES AND MATERIALS, INC., HAMPTON, VA.
Delamination onset in polymeric composite laminates under thermal and mechanical loads
[NASA-CR-189548] N92-14432

ARGONNE NATIONAL LAB., IL.
A novel phase transition in alloys
[DE92-000366] N92-14161
Recent advantages in processing and fabrication of ceramic superconductors
[DE91-018548] N92-14291
Applications of energetic particles in improving coating adhesion properties N92-14461
Regional analysis of S emission-deposition trends in North America from 1979 through 1988
[DE91-018545] N92-14489
The carbon isotopic composition of atmospheric methane and its sources and trends; distribution of source fluxes and their contribution to the increasing concentration
[DE92-000268] N92-14491
Z(sup 0) yields hadrons in SDC
[DE92-000294] N92-14800

ARIZONA UNIV., TUCSON.
Ceramics derived from organo-metallic precursors
[AD-A241849] N92-14172
Research studies on advanced optical module/head designs for optical devices
[NASA-CR-189756] N92-14902
Characterization of magneto-optical media N92-14903
Wavelength dependencies of the Kerr rotation and ellipticity for the magneto-optical recording media N92-14904
Comparison of different fractal dimension measuring algorithms for RE-TM M-O films N92-14905
Coercivity of domain wall motion in thin films of amorphous rare earth-transition metal alloys N92-14906
Effect of patch borders on coercivity in amorphous rare earth-transition metal thin films N92-14907
Sources of noise in magneto-optical readout N92-14908
Differential spot-size focus servo N92-14909
Measurement of laser spot quality N92-14910
Laser beam modeling in optical storage systems N92-14911
Micro-optic lens for data storage N92-14912
Use of rigorous vector coupled-wave theory for designing and tolerancing surface-relief diffractive components for magneto-optical heads N92-14913
Practical design considerations and performance characteristics of high numerical aperture holographic lenses N92-14914
Effects of beam focusing on the efficiency of planar waveguide grating couplers N92-14915
Jitter model and signal processing techniques for pulse width modulation optical recording N92-14916
ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Investigations of freshwater and ice surveying using short-pulse radar
[AD-A241435] N92-14440
ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
Modeling nonlinear acoustical blast waves outdoors: A research summary
[AD-A241030] N92-14792
ARMY TANK-AUTOMOTIVE COMMAND, WARREN, MI.
Thermal wave imaging examples and applications
[AD-A240982] N92-14124
ARNOLD ENGINEERING DEVELOPMENT CENTER, ARNOLD AIR FORCE STATION, TN.
Signal conditioning of single-active-arm strain gages used for dynamic stress measurement
[AD-A241187] N92-14331
ARRAY SYSTEMS COMPUTING, INC., DOWNSVIEW (ONTARIO).
Automated baggage threat detection N92-14032
ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON (ENGLAND).
Solubility of calcium in CaO-CaCl2
[AWE-0-16/90] N92-14140
AUBURN UNIV., AL.
Silicon device performance measurements to support temperature range enhancement
[NASA-CR-189522] N92-14295
AVIATION INST., BUCHAREST (ROMANIA).
On a global aerodynamic optimization of a civil transport aircraft N92-13931
AVIATION PLANNING SERVICES LTD., MONTREAL (QUEBEC).
A strategy for exploiting the full potential of MLS based terminal procedures in Canada N92-14025

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
Applications of Fourier transform infrared photoacoustic spectroscopy to solid propellant characterization
[AD-A240857] N92-14180
Fundamental studies of laser ignition and kinetics in reactive gases
[AD-A241463] N92-14334
BEIJING UNIV. (CHINA).
An inverse method with regularity condition for transonic airfoil design N92-13969
BELEIDSCOMMISSIE REMOTE SENSING, DELFT (NETHERLANDS).
Assimilation of TIR imagery in numerical models as a tool for water management
[BCRS-90-36] N92-14441
Modelling and synergetic use of optical and microwave remote sensing. Report 2: LAI estimation from canopy reflectance and WDVI: A sensitivity analysis with the SAIL model
[BCRS-90-39] N92-14442
Application of SPOT in the Tai area (Ivory Coast)
[BCRS-90-41] N92-14443
Measurements with SHIRA in the ERS-1 rehearsal campaign
[BCRS-91-03] N92-14444
BENDIX FIELD ENGINEERING CORP., COLUMBIA, MD.
Using C to build a satellite scheduling expert system: Examples from the Explorer Platform planning system
[NASA-CR-189247] N92-14700
BENTLY ROTOR DYNAMICS RESEARCH CORP., MINDEN, NV.
Rotor-to-stator partial rubbing and its effects on rotor dynamic response N92-14367
Comments on frequency swept rotating input perturbation techniques and identification of the fluid force models in rotor/bearing/seal systems and fluid handling machines N92-14370
BODENSEEWERK GERAETETECHNIK G.M.B.H., UEBERLINGEN (GERMANY, F.R.).
Introduction to neural computing and categories of neural network applications to guidance, navigation and control N92-14674
BOEING CO., SEATTLE, WA.
Flyover-noise measurement and prediction N92-14786
Quiet aircraft design and operational characteristics N92-14787
BOEING COMPUTER SERVICES CO., SEATTLE, WA.
A comparison of two closely-related approaches to aerodynamic design optimization N92-13933
BOEING MILITARY AIRPLANE DEVELOPMENT, SEATTLE, WA.
Historical perspective on the evolution of avionics standards N92-14049
BRITISH AEROSPACE PUBLIC LTD. CO., BRISTOL (ENGLAND).
Neural networks for military robots N92-14680
BRITISH AEROSPACE PUBLIC LTD. CO., STEVENAGE (ENGLAND).
An advanced OBP-based payload operating in an asynchronous network for future data relay satellites utilising CCSDS-standard data structures N92-14226
BROOKHAVEN NATIONAL LAB., UPTON, NY.
The new BNL polarized negative ion source
[DE92-000134] N92-14799
BROWN UNIV., PROVIDENCE, RI.
Applications of neural networks in high energy physics
[DE90-013325] N92-14825

C

CALIFORNIA POLYTECHNIC STATE UNIV., SAN LUIS OBISPO.
Material property for designing, analyzing, and fabricating space structures
[NASA-CR-189516] N92-14119
CALIFORNIA UNIV., BERKELEY.
Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures
[DE92-000903] N92-14150
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Surface vibrational spectroscopy of pure liquids
[DE92-000843] N92-14135
The puzzles of surface science and recent attempts to explain them
[DE92-000926] N92-14136
Cluster expansion of fcc Pd-V intermetallics
[DE92-000842] N92-14147
Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys
[DE92-000900] N92-14149
On the micromechanisms of fatigue-crack propagation in aluminum-lithium alloys: Sheet vs plate material
[DE92-000926] N92-14151
Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material
[DE92-000927] N92-14152
Distribution of ion-implanted yttrium in Cr2O3 scale and in the underlying Ni-25 wt percent Cr alloy
[DE92-000734] N92-14155
Theory of ordering transformations in metals and minerals
[DE92-000855] N92-14157
Design, microstructure, and high-temperature behavior of silicon nitride sintered with rare-earth oxides
[DE92-000815] N92-14175
Pre-tinning and flux considerations on the reliability of solder surface
[DE92-000905] N92-14189
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
Micro-scale mass-transfer variations during electrodeposition
[DE92-000907] N92-14290
TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow
[DE92-000755] N92-14316
A 2-D imaging heat-flux gauge
[DE92-000153] N92-14332
Photon storage cavities
[DE92-000921] N92-14338
Discrete cavity model of a standing-wave free-electron laser
[DE92-000839] N92-14340
Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation
[DE92-000859] N92-14341
Fuel processing and thermochemical/photochemical cycles N92-14472
Options for reducing carbon dioxide emissions
[DE92-000906] N92-14494
Electromagnetic field effects on cells of the immune system: The role of calcium signalling
[DE92-000852] N92-14583
GAMUT: A computer code for (gamma)-ray energy and intensity analysis
[DE92-000691] N92-14609
Recent developments in the Virasoro master equation
[DE92-000811] N92-14703
Magnetic field in the end region of the SSC quadrupole magnet
[DE92-000850] N92-14778
Dynamic-angle spinning and double rotation of quadrupolar nuclei
[DE92-000837] N92-14808
Laser diagnostics of H(-) formation in a magnetic multicusp ion source
[DE92-000940] N92-14815
Crystal structure of stage 1 iodine intercalated superconducting IBi2Sr2CaCu2O(x)
[DE92-000849] N92-14866
Non-stoichiometric defects in YBaCuO thin films
[DE92-000954] N92-14867
Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100)
[DE92-000868] N92-14872
Theoretical modeling and experimental characterization of planar defects in Y2Ba4Cu(6+x)O(14+x)
[DE92-000898] N92-14873
Vertical bridgman and gradient freeze growth of 3-5 compound semiconductors
[DE92-000893] N92-14876
Rotating relativistic neutron stars
[DE92-000806] N92-14941
CALIFORNIA UNIV., DAVIS.
Effectiveness of large booms as nutation dampers for spin stabilized spacecraft N92-14088
Fault-tolerant multichannel demultiplexer subsystems N92-14220
Baseband pulse shaping techniques for nonlinearly amplified pi/4-QPSK and QAM systems N92-14234
Some partial-unit-memory convolutional codes N92-14243
CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.
Synthesis of mismatched heterojunction/substrate interfaces
[AD-A241845] N92-14283
Parameterization of intermittant turbulence and the vorton method
[DE92-000758] N92-14317
Processing complexity of two approaches to object detection and recognition N92-14677
Advance neural network architectures for guidance and control N92-14682
CAMBRIDGE UNIV. (ENGLAND).
Deformation, fracture and explosive properties of reactive materials
[AD-A241123] N92-14181
CANADIAN ASTRONAUTICS LTD., OTTAWA (ONTARIO).
Guidance angle measurement of an MLS antenna N92-14011
CANADIAN MARCONI CO., MONTREAL (QUEBEC).
Testing of CMA-2000 Microwave Landing System (MLS) airborne receiver N92-14023
CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
A model of the self-explanation effect
[AD-A241200] N92-14684
CATHOLIC UNIV. OF AMERICA, WASHINGTON, DC.
Computational methods for superlattice structures: Renormalization and recursion techniques
[AD-A241176] N92-14277

CENTER FOR MATHEMATICS AND COMPUTER SCIENCE, AMSTERDAM (NETHERLANDS).
Triangle sets in PHIGS PLUS: A valuable link with finite element modeling
[CWI-CS-R9110] N92-14655
A new device for the synthesis problem of optimal control of admission to an M/M/c queue
[CWI-BS-R9101] N92-14698
Idempotents
[CWI-AM-R9101] N92-14741
Riccati and soliton equations
[CWI-AM-R9103] N92-14742
Convergence, continuity and iteration in mathematical morphology
[CWI-BS-R9104] N92-14743
Induced circuits in planar graphs
[CWI-BS-R9106] N92-14744
State space formulas for transfer poles at infinity
[CWI-BS-R9108] N92-14748
Asymptotic inversion of incomplete gamma functions
[CWI-AM-R9102] N92-14759
Random additive functionals with rapid Markov switchings
[CWI-AM-R9104] N92-14760
Optimal choice of sample fraction in extreme-value estimation
[CWI-BS-R9107] N92-14761
Recognition of overlapping objects using Markov spatial processes
[CWI-BS-R9109] N92-14763
Zero drift random walk on N by N with reflection, ergodicity conditions
[CWI-BS-R9114] N92-14770

CENTRE D'ESSAIS AERONAUTIQUE TOULOUSE (FRANCE).
Mechanical qualification tests for materials used in the fabrication of aircraft parts
[CEAT-M5-5443/01] N92-14042
Optimization of the calculation margins of landing gears under extreme loads. Rupture static tests. Part 1: Program and test implantation
[CEAT-S8-6551-PARTIEL-1-PT-1] N92-14043

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, ORSAY (FRANCE).
The turbomachine blading design using S2-S1 approach N92-13940

CENTRO BRASILEIRO DE PESQUISAS FISICAS, RIO DE JANEIRO.
Qualitative analysis of cosmological models in Brans-Dicke theory, solutions from non-minimal coupling and viscous universe
[DE91-634422] N92-14940

CESKOSLOVENSKA VEDECKOTECHNICKA SPOLECNOST, PRAGUE.
International Conference on Advanced Methods in X Ray and Neutron Structure Analysis of Materials
[DE91-639071] N92-14871

CHEMICAL WASTE MANAGEMENT, INC., GENEVA, IL.
Solar technology applications in chemical waste management N92-14459

CHICAGO UNIV., IL.
Solar pumped lasers: Work in progress at the University of Chicago N92-14466

CHINA NUCLEAR INFORMATION CENTRE, BEIJING.
Development of plasma current waveform adjusting system ZLJ for tokamak device HL-1
[DE91-628424] N92-14854

CHINA SHIP SCIENTIFIC RESEARCH CENTER, WUXI.
A numerical research of nonlinear body-wave interactions N92-14302

CINCINNATI UNIV., OH.
Numerical identification of boundary conditions on nonlinearly radiating inverse heat conduction problems N92-13945
Comparison of four stable numerical methods for Abel's integral equation N92-13946
A neural network architecture for implementation of expert systems for real time monitoring
[NASA-CR-188988] N92-14669
Automated implementation of rule-based expert systems with neural networks for time-critical applications N92-14670

COLORADO STATE UNIV., FORT COLLINS.
Study of improved methods for predicting chemical equilibria
[DE91-018803] N92-14129

COLORADO UNIV., BOULDER.
Variational formulation of high performance finite elements: Parametrized variational principles
[NASA-CR-189064] N92-14383
Electromagnetic finite elements based on a four-potential variational principle
[NASA-CR-189067] N92-14392
A variational justification of the assumed natural strain formulation of finite elements
[NASA-CR-189063] N92-14393
Analysis of superconducting electromagnetic finite elements based on a magnetic vector potential variational principle
[NASA-CR-189090] N92-14436
Gravity and the geoid in the Nepal Himalaya
[NASA-CR-189523] N92-14560

COLSA, INC., HUNTSVILLE, AL.
Adaptive optical processor
[AD-A241535] N92-14837

COLUMBIA UNIV., NEW YORK, NY.
Adjoint operator approach to shape design for internal incompressible flows N92-13957
Absorption of the x ray background by the large magellanic cloud
[NASA-CR-189462] N92-14945

COMISION NACIONAL DE ENERGIA ATOMICA, BUENOS AIRES (ARGENTINA).
Bulk and interface dielectric functions: New results within the tight-binding approximation
[DE91-641606] N92-14292
Acoustic emission
[DE91-642293] N92-14796

COMMITTEE ON APPROPRIATIONS (U.S. SENATE).
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[S-REPT-102-107] N92-14920
National Aeronautics and Space Administration N92-14921
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992
[S-REPT-102-107] N92-14924
National Aeronautics and Space Administration N92-14925
Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations for fiscal year 1992, part 2
[S-HRG-102-113-PT-2] N92-14926
National Aeronautics and Space Administration N92-14927

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION (U.S. SENATE).
NASA's fiscal year 1992 budget overview
[S-HRG-102-269] N92-14928
NASA's plan to restructure the Space Station Freedom
[S-HRG-102-268] N92-14929

COMMUNICATIONS GILLIES, INC., SAINTE LAMBERT (QUEBEC).
Electronic systems in transportation
[TP-9983] N92-14009

COMMUNICATIONS SATELLITE CORP., CLARKSBURG, MD.
On-board processing architectures for satellite B-ISDN services N92-14203
Satellite communications for the next generation telecommunication services and networks N92-14207
Satellite B-ISDN traffic analysis N92-14208
On-board demux/demod N92-14221
COMSAT Laboratories' on-board baseband switch development N92-14225
A B-ISDN-compatible modem/codec N92-14229
Programmable digital modem N92-14231

COMPENGSERV LTD., OTTAWA (ONTARIO).
A unique approach to aircraft conflict resolution using artificial intelligence techniques N92-14029
A neural network design methodology: Considerations and issues for design and project management N92-14676
Vision systems for guidance and control: A tutorial overview N92-14679

COMPUTER SCIENCES CORP., HAMPTON, VA.
Analysis of objects in binary images
[NASA-CR-4420] N92-14598

COMPUTER SCIENCES CORP., LANHAM, MD.
COBE experience with filter QUEST N92-14078
Evidence of chaotic pattern in solar flux through a reproducible sequence of period-doubling-type bifurcations N92-14081
Propellant-remaining modeling N92-14096

COMPUTER SCIENCES CORP., LAUREL, MD.
The in-flight calibration of the Hubble Space Telescope attitude sensors N92-14090

COMPUTER TECHNOLOGY ASSOCIATES, INC., ROCKVILLE, MD.
Standard formatted data units-control authority operations
[NASA-CR-188748] N92-14896
Standard formatted data units-control authority procedures
[NASA-CR-188127] N92-14897

COMPUTER TECHNOLOGY ASSOCIATES, INC., MCKEE CITY, NJ.
Evaluation of triple simultaneous parallel ILS approaches spaced 4300 feet apart, phase 4a
[ACD-340] N92-14034

CONGRESS OF THE UNITED STATES, WASHINGTON, DC.
Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1992
[HR-2519-PP] N92-14922
National Aeronautics and Space Administration N92-14923

CORNELL UNIV., ITHACA, NY.
Turbulence measurements in axisymmetric jets of air and helium N92-14299
Integrating security in a group oriented distributed system
[NASA-CR-189498] N92-14656
Defect studies in 3-5 thin film semiconductors
[DE92-000052] N92-14875
Radio frequency investigations of the interstellar medium N92-14936

COUNCIL FOR NATIONAL ACADEMIC AWARDS (ENGLAND).
Transhorizon microwave propagation and its relationship with meteorological conditions N92-14201

D

DAVID TAYLOR RESEARCH CENTER, BETHESDA, MD.
Navier-Stokes analysis of turbulent boundary layer and wake for two-dimensional lifting bodies N92-14309

DAYTON UNIV., OH.
Training evaluation of the F-15 advanced air combat simulation
[AD-A241675] N92-14067
High-temperature photochemistry induced by concentrated solar radiation N92-14457
Transfer of training from a radar intercept part-task trainer to an F-16 flight simulator
[AD-A241493] N92-14588
Contractor-supported aircrew training systems: Issues and lessons learned
[AD-A241590] N92-14589
B-52 and KC-135 mission qualification and continuation training: A review and analysis
[AD-A241591] N92-14590

DEFENCE RESEARCH ESTABLISHMENT PACIFIC, VICTORIA (BRITISH COLUMBIA).
Filter debris analysis: A concrete approach to wear diagnosis
[DREP-TM-88-20] N92-14345

DELAWARE UNIV., NEWARK.
Charge-sign dependent solar modulation of 1-10 GeV cosmic rays N92-14954

DEPARTMENT OF THE ARMY, WASHINGTON, DC.
White light optical fourier transform device
[AD-D015022] N92-14838

DEPARTMENT OF THE NAVY, WASHINGTON, DC.
Pyrofuze aircraft ordnance arming system
[AD-D015024] N92-14040
Muffler for air powered turbine drive
[AD-D015034] N92-14062
Electrochemical noise measurement technique for the determination of aluminum alloy pit initiation rates
[AD-D015050] N92-14144
Inhibitor and barrier for use with high energy rocket propellants
[AD-D015023] N92-14182
Insensitive high density explosive
[AD-D015026] N92-14183
Binders for melt castable plastic bonded explosives
[AD-D015032] N92-14184
A method and apparatus for signal prediction in a time-varying signal system
[AD-D015021] N92-14258
Insulator assisted self-aligned gate junction
[AD-D014995] N92-14279
Edge-emitting diode-to-optical fiber coupling technique
[AD-D014997] N92-14280
Electrical power supply for short term power interruptions
[AD-D014998] N92-14281
Method and apparatus for synchronization of dynamical physical systems
[AD-D015020] N92-14376
High pressure fiber optic connector plug
[AD-D015033] N92-14839

DEPARTMENT OF TRANSPORTATION, CAMBRIDGE, MA.
Testing MLS DME/P transponders and interrogators N92-14020

DEUTSCHE AIRBUS G.M.B.H., BREMEN (GERMANY, F.R.).
Application of direct inverse analogy method (DIVA) and viscous design optimization techniques N92-13951
A concept for the revisions of structural inspection schedules N92-14431
DEUTSCHE AIRBUS G.M.B.H., HAMBURG (GERMANY, F.R.).
Fatigue behaviour of circumferential joints N92-14421
Airbus Industrie A330/A340: Full scale fatigue test of center fuselage and wing N92-14425
Methodology for assessment of skin repairs on Airbus aircraft N92-14428
DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (GERMANY, F.R.).
Image-supported navigation for testing instrument landing systems N92-14012
DME growth elements and their use with MLS N92-14018
A Taxi And Ramp Management And Control system (TARMAC) N92-14027
DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (GERMANY, F.R.).
Investigation on size effects of multidirectional notched CFRP laminates under fatigue loading N92-14412
Constitutive relations for UD-layers in crossply laminates damaged by fatigue loading N92-14415
Interlaminar delamination growth of graphite/epoxy composites under consideration of cyclic energy release rates for life prediction N92-14417
DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN (GERMANY, F.R.).
Extended mapping and characteristics techniques for inverse aerodynamic design N92-13949
DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (GERMANY, F.R.).
Radiation from a dipole antenna into an inhomogeneous, comprehensible, and nonlinear space-plasma [DLR-FB-91-05] N92-14269
Shadow technique for improved inversion of lidar data to cirrus and contrail optical depth [DLR-FB-91-07] N92-14571
Anisotropic reflection in mountainous terrain to determine the absorption of solar radiation from satellite data [DLR-FB-91-06] N92-14959
DEUTSCHER WETTERDIENST, HAMBURG (GERMANY, F.R.).
Response level of precipitation sensors [ETN-92-90311] N92-14573
DORNIER SYSTEM G.M.B.H., FRIEDRICHSHAFEN (GERMANY, F.R.).
Static and dynamic strength of joints in ARALL-laminates N92-14423
DU PONT DE NEMOURS (E. I.) AND CO., WILMINGTON, DE.
Photochemical synthesis N92-14469
DUKE UNIV., DURHAM, NC.
Analytical/numerical matching and periodic inversion: Two advances in free wake analysis N92-13994

E

E-SYSTEMS, INC., SALT LAKE CITY, UT.
DME/P transponder reply delay accuracy: Factory verification and calibration N92-14019
ECOLE NATIONALE SUPERIEURE DES TELECOMMUNICATIONS, PARIS (FRANCE).
Pattern recognition in pulmonary computerized tomography images using Markovian modeling [TELECOM-PARIS-91-C-002] N92-14584
ECOLE POLYTECHNIQUE, MONTREAL (QUEBEC).
Thermal, thermochemical, and hybrid solar hydrogen production N92-14474
EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, ID.
Phosphazene polymer membranes: Hazardous chemical removal from gas and liquid feedstreams [DE91-013217] N92-14169
Solvent substitution with non-chlorinated biodegradable solvents [DE91-018708] N92-14176
Nuclear technologies for Moon and Mars exploration [DE91-018832] N92-14951
EDINBURGH UNIV. (SCOTLAND).
The stratospheric residual circulation as deduced from satellite data N92-14498
ELORET CORP., PALO ALTO, CA.
Performance analysis of advanced spacecraft TPS [NASA-CR-188694] N92-14098
ELORET CORP., SUNNYVALE, CA.
An experimental investigation of the separating/reattaching flow over a backstep [NASA-CR-189495] N92-14314
ENVIRONMENTAL PROTECTION AGENCY, ATHENS, GA.
Water treatment: Advanced photooxidation processes N92-14446
EUROPEAN SPACE AGENCY, PARIS (FRANCE).
Study and modelling of the mechanical behaviour of a nickel-base single crystal superalloy for turbine blade [ESA-TT-1180] N92-14168
Ranging standard. Volume 1: Direct ground to spacecraft ranging [ESA-PSS-04-104-VOL-1-ISSUE-2] N92-14268
Active vibration damping of flexible structure [ESA-TT-1217] N92-14438
EUROPEAN SPACE AGENCY. EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, ESTEC, NOORDWIJK (NETHERLANDS).
Software product assurance requirements for ESA space systems [ESA-PSS-01-21-ISSUE-2] N92-14631
EXECUTIVE RESOURCE ASSOCIATES, INC., ARLINGTON, VA.
General aviation activity and avionics survey, calendar year 1989 [PB91-179234] N92-13926

F

FACHHOCHSCHULE, WILHELMSHAVEN (GERMANY, F.R.).
Database on fatigue of welded aluminium components ALUFAT N92-14399
Stress intensity factors for structural details of welded components N92-14407
Crack growth measurements using corner-crack- or LCF-specimens N92-14408
FEDERAL AVIATION ADMINISTRATION, ATLANTIC CITY, NJ.
Data Multiplexing Network (DMN) phase 3 equipment Operational Test and Evaluation (OT and E)/integration test report [DOT/FAA/CT-TN91/50] N92-14270
FEDERAL AVIATION ADMINISTRATION, WASHINGTON, DC.
FAA statistical handbook of aviation: Calendar year 1989 [PB91-202051] N92-13927
Terminal area forecasts: FY 1991-2005 [AD-A241489] N92-14005
FERMI NATIONAL ACCELERATOR LAB., BATAVIA, IL.
Performance of a new monolithic eight channel charge sensitive preamplifier-shaper [DE92-000599] N92-14287
FIAT AVIAZIONE S.P.A., TURIN (ITALY).
Research on inverse methods and optimization in Italy N92-13956
FLORIDA ATLANTIC UNIV., BOCA RATON.
The application of experimental data to blade wake interaction noise prediction [NASA-CR-189461] N92-14789
FLORIDA UNIV., GAINESVILLE.
Formal and heuristic system decomposition methods in multidisciplinary synthesis [NASA-CR-4413] N92-14041
Pulsed laser processing of solar cells N92-14462
FRAUNHOFER-INST. FUER BETRIEBSFESTIGKEIT, DARMSTADT (GERMANY, F.R.).
Review of investigations on aeronautical fatigue in the Federal Republic of Germany [ETN-92-90317] N92-14397
About the effect of loading sequence on the fatigue life of notched specimens made from steel and aluminium alloys N92-14398
Influence of porosity on fatigue behaviour of cast aluminium alloys N92-14403
Improvement of fatigue behaviour of sintered steels by surface rolling N92-14404
Fracture toughness and crack propagation behaviour of aluminium 2219 T87 N92-14410
Fatigue of repaired composite structures N92-14411
Environmental fatigue tests with composite materials N92-14413
Development of a new design method to predict impact damage tolerance of composite structures N92-14416
Delamination imaging in CFRP laminates N92-14418
Strength behaviour of adhesively shrink-bonded shaft-hub assemblies under torsional loading N92-14419
Design and fatigue behaviour of a CFRP/titanium joint for the propfan engine CRISP N92-14420

G

GAS RESEARCH INST., CHICAGO, IL.
Gas Research Institute experience in solar fuel research N92-14473
GENERAL DYNAMICS/ELECTRONICS, SAN DIEGO, CA.
Neural network paradigms N92-14675
Multisensor data fusion as applied to guidance and control N92-14681
GENERAL ELECTRIC CO., CINCINNATI, OH.
An inverse method for the aerodynamic design of three-dimensional aircraft engine nacelles N92-13958
A simplified method for predicting the stability of aerodynamically excited turbomachinery N92-14364
Design and performance of duct acoustic treatment N92-14783
Jet noise suppression N92-14784
GENERAL SCIENCES CORP., LAUREL, MD.
Colored noise effects on batch attitude accuracy estimates N92-14093
GENERAL SCIENCES CORP., SOUDERTON, PA.
Self-propagating reactions for synthesis of high temperature materials [AD-A241660] N92-14171
GEORGIA INST. OF TECH., ATLANTA.
Definition of the unsteady vortex flow over a wing/body configuration [NASA-CR-180083] N92-13995
Image-based ranging and guidance for rotorcraft [NASA-CR-184829] N92-14036
Integration of dynamic, aerodynamic, and structural optimization of helicopter rotor blades [NASA-CR-189018] N92-14038
Rapid near-optimal aerospace plane trajectory generation and guidance [NASA-CR-189469] N92-14066
Improved finite element analysis of thick laminated composite plates by the predictor corrector technique and approximation of C sup 1 continuity with a new Least Squares element N92-14116
Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS) [DE91-018526] N92-14126
Termolecular association and laser-assisted electron-(excited) atom collisions [AD-A241647] N92-14802
GEORGIA TECH RESEARCH INST., ATLANTA.
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 1, task 1: Digital Emulation Technology Laboratory [AD-A241691] N92-14657
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 2, task 1: Digital Emulation Technology Laboratory [AD-A241692] N92-14658
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 1, part 3, task 1: Digital emulation technology laboratory [AD-A241693] N92-14659
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 2, task 2: Seeker scene emulator development [AD-A241694] N92-14660
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 4, task 4: Software development [AD-A241695] N92-14661
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 5, task 5: GN/C processor development and PFP integration [AD-A241696] N92-14662
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 6, task 6: GN/C processor test and evaluation [AD-A241697] N92-14663
Guidance, Navigation and Control Digital Emulation Technology Laboratory. Volume 7, task 7: VLSI development [AD-A241698] N92-14664
GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, MOSCOW (USSR).
Extended (N=4) supergravity as a result of reduction from 10-dimensional space [DE91-628071] N92-14559
Hamiltonian reduction of Wess-Zumino-Witten theory from the point of view of bosonization [DE91-634069] N92-14704
Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group [DE91-623503] N92-14710
Hydrodynamical analysis of azimuthal two-particle correlations in relativistic heavy-ion collisions [DE91-637356] N92-14807

Simulation of steady current maintaining in a tokamak thermonuclear reactor with neutral atom beam injection
[DE91-636815] N92-14847
Current generation by neutral beam injection in a non-circular tokamak
[DE91-636816] N92-14848
Anisotropy of relativistic lepton coherent scattering at axial channeling
[DE91-623659] N92-14874
Two-loop free energy for finite temperature SU(2) gauge theory in a constant external field
[DE91-628109] N92-14881
1/N-expansion in quantum mechanics, part 1
[DE91-635986] N92-14882
1/N-expansion in quantum mechanics, part 2
[DE91-635987] N92-14883

GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, OBNINSK (USSR).
Vanadium and tantalum frequency spectrum deformation by interstitial impurities
[DE91-623605] N92-14160

GOSUDARSTVENNYI KOMITET PO ISPOLZOVANIYU ATOMNOI ENERGII, SERPUKHOV (USSR).
Excess noise of secondary emission in the frequency range of (10(exp -3) - 10(exp -1)) Hz
[DE91-639556] N92-14286
Energy-momentum tensor of the gravitational field for material spheres
[DE91-628070] N92-14558
New examples of continuum graded Lie algebras
[DE91-623480] N92-14709
The algebra of Killing vectors in five-dimensional space
[DE91-635976] N92-14765
New parametrization of multiplicity distribution in pp and p(-p) inelastic interactions
[DE91-637100] N92-14805
To acceleration and focusing theory in RF quadrupoles
[DE91-638997] N92-14827
Influence of the superconducting energy gap on the line width of the crystal field transition in the high Tc superconductor Tm(0.1)Y(0.9)Ba2Cu3O(6.9)
[DE91-636317] N92-14869
Relativistic theory of gravitation based on the constant curvature space
[DE91-636027] N92-14884
On the fundamental principles of the relativistic theory of gravitation
[DE91-636029] N92-14885
Gross-Neveu model and optimized expansion method
[DE91-636082] N92-14886
Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton
[DE91-623494] N92-14946

GRONINGEN RIJKSUNIV. (NETHERLANDS).
Finite-dimensional robust controller designs for distributed parameter systems: A survey
[W-9104] N92-14699

H

HARRIS CORP., MELBOURNE, FL.
Flexible High Speed Codec (FHSC) N92-14230

HARVARD UNIV., CAMBRIDGE, MA.
Oceanographic and topographic interactions in underwater acoustic propagation, with regional applications
[AD-A241317] N92-14794

HAWAII UNIV., MANOA.
Multi-stage decoding of multi-level modulation codes N92-14233

HECHT-NIELSEN NEUROCOMPUTER CORP., INC., SAN DIEGO, CA.
Processing complexity of two approaches to object detection and recognition N92-14677
Advance neural network architectures for guidance and control N92-14682

HELSINKI UNIV. OF TECHNOLOGY, ESPOO (FINLAND).
Applications of ultra-high vacuum technique to surface and near-surface studies
[ETN-92-90454] N92-14141

HELSINKI UNIV. OF TECHNOLOGY, KYLMAELAE (FINLAND).
A statistical determination method of cylinder combustion conditions using the cyclic variations of some measurable engine variables
[ACTA-POLITEC-SCAND-ME-98] N92-14142

HEWLETT-PACKARD LABS., PALO ALTO, CA.
Intelligent network management and functional cerebellum synthesis N92-14697

HONEYWELL, INC., GLENDALE, AZ.
Fault-tolerance techniques for high-speed fiber-optic networks N92-14219

HONEYWELL, INC., MINNEAPOLIS, MN.
A study of mass data storage technology for rocket engine data
[NASA-CR-185272] N92-14110

I

ILLINOIS STATE WATER SURVEY, CHAMPAIGN.
A comparison of advanced oxidation processes with semiconductor-catalyzed photo-oxidation N92-14450

ILLINOIS UNIV., CHICAGO.
Molecular design concept for x ray laser research
[DE92-000972] N92-14343

ILLINOIS UNIV., URBANA.
Optimal design of solidification processes N92-13944

ILLINOIS UNIV. AT URBANA-CHAMPAIGN, SAVOY.
Bandwidth-limited robust nonlinear spacecraft control N92-14100

INDUSTRIEANLAGEN-BETRIEBSGESELLSCHAFT M.B.H., OTTOBRUNN (GERMANY, F.R.).
Assessment of the fatigue behaviour of the microalloyed steels 27MnVS6 and 38MnVS5 N92-14400
Mechanical properties of PM aluminium alloys N92-14402
Low cycle fatigue of cast nickel base turbine rotors N92-14405
LCF-behaviour of turbine steels under crevice corrosion conditions N92-14406
Influence of test temperature and dwell times on the crack propagation behaviour of Udimet 700 P/M-HIP N92-14409
Comparison between hot/wet test and RT/dry test on the Seastar horizontal stabilizer and fin N92-14414
Effect of corrosive environment on fatigue life of bonded steel joints N92-14422
Probabilistic lifing approach for aero engine disks made of powder nickel base alloys containing ceramic defects N92-14424
Constant amplitude and spectrum loading fatigue behaviour of spheroidal cast iron N92-14429

INNOVATIVE TEXTILE APPLICATIONS CO., GRAND JUNCTION, CO.
Universal weaving for turbine engine composite preforms
[AD-A237667] N92-14059

INSTITUT NATIONAL DES SCIENCES APPLIQUEES, LYON (FRANCE).
Characterization of piezoelectric materials: Modeling of losses at grain boundaries and at domain walls
[ISAL-91-0014] N92-14877

INSTITUTE FOR WATER RESOURCES, FORT BELVOIR, VA.
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[AD-A240797] N92-14791

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[DE91-641867] N92-14835
Another treatment of the relation between classical and quantum mechanics
[DE91-641534] N92-14891
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[DE91-641846] N92-14947

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[DE91-624093] N92-14809
Isotopes in everyday life
[DE91-642281] N92-14820
ITER diagnostics
[DE91-626549] N92-14851
Twin loops for vertical control of highly elongated plasma
[DE91-626554] N92-14852
ITER conceptual design activities
[DE91-626576] N92-14853
Physics and technology R and D for ITER conceptual design. Part A: Physics, Part B: Technology
[DE91-640899] N92-14860
ITER parametric analysis and operational performance
[DE91-640901] N92-14861

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE (ITALY).
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[DE91-635167] N92-14259
Modelling of the axial-flow gas laser
[DE91-635597] N92-14337
High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications
[DE91-623551] N92-14342
On the theory of polar ozone holes
[DE91-635165] N92-14486
Generalized expressions for variations in critical frequencies, electron densities and altitudes of the ionospheric layers
[DE91-635168] N92-14556
A new process by which the general circulation system is maintained
[DE91-635154] N92-14567
An analytical model for climatic predictions
[DE91-635156] N92-14568
Physical processes responsible for ENSO events
[DE91-635166] N92-14569
The effect of ultrasound on arterial blood flow. Part 1: Steady fully developed flow
[DE91-635323] N92-14585
The techniques of optical fibre measurements: An overall description
[DE91-635892] N92-14840
On topological symmetries and the Goldstone Theorem
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Laboratory measurements of on-board subsystems N92-14216
On-board processing for telecommunications satellites N92-14227

ISTITUTO NAZIONALE DI STUDI ESPE ARCHITETTURA NAVALE, ROME (ITALY).
A boundary integral approach in primitive variables for free surface flows N92-14304

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[NASA-CR-189484] N92-14237
A receiver design for the superconducting cavity-maser oscillator N92-14238
Suppressed carrier full-spectrum combining N92-14239
A comparison of the fractal and JPEG algorithms N92-14240
A portable Ku-band front-end test package for beam-waveguide antenna performance evaluation N92-14244
A proposed far-field method for frequency-stability measurements on the DSS 13 beam-waveguide antenna N92-14245
The L-/C-band feed design for the DSS 14 70-meter antenna (Phobos mission) N92-14246
Mark 4A antenna control system data handling architecture study N92-14247
Expected antenna utilization and overload N92-14248
Trajectory and navigation system design for robotic and piloted missions to Mars N92-14249
A 640-MHz 32-megachannel real-time polyphase-FFT spectrum analyzer N92-14250
Polyphase-discrete Fourier transform spectrum analysis for the Search for Extraterrestrial Intelligence sky survey N92-14251
The behavior of quantization spectra as a function of signal-to-noise ratio N92-14252
Some practical universal noiseless coding techniques, part 3, module PSI14,K+
[NASA-CR-188718] N92-14611
Center for Space Microelectronics Technology
[NASA-CR-189451] N92-14771
Solid state devices N92-14772
Photonics N92-14773
Advanced computing N92-14774
Custom microcircuits N92-14775

JOHNS HOPKINS UNIV., BALTIMORE, MD.
A minimalist approach to receiver architecture N92-14241
Determinate-state convolutional codes N92-14242
JOHNS HOPKINS UNIV., LAUREL, MD.
New quests for better attitudes N92-14077
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[DE91-632213] N92-14596
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[DE91-638281] N92-14146
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[DE91-628387] N92-14177
Basic procedure of measuring the relativistic length and its modifications
[DE91-628072] N92-14260
Some physical applications of nonstandard logical systems
[DE91-628005] N92-14707
Potential reconstruction from R-matrix resonance positions and reduced widths
[DE91-628029] N92-14708
Stochasticity in the spectrum of some Hamiltonians with discrete symmetry
[DE91-628033] N92-14749
Antiparticles
[DE91-636031] N92-14810
Anisotropic space-time
[DE91-636032] N92-14811
Classical theory of a structural point object in the 2nd order approximation
[DE91-628031] N92-14818
On the high-energy potential scattering theory in the method of evolution with respect to coupling constant
[DE91-628032] N92-14834
Inelastic neutron scattering in the anharmonic model of high-Tc superconductors
[DE91-636318] N92-14870
Some physical applications of nonstandard logical systems
[DE91-628004] N92-14887
On the summability of the spectral shift function for pairs of contractions and dissipative operators
[DE91-628030] N92-14888
Fedorov universal equations in the string and membrane theories
[DE91-628073] N92-14889
Phase space structure in gauge theories
[DE91-623483] N92-14890
Another treatment of the relation between classical and quantum mechanics
[DE91-641534] N92-14891
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Small solar sail spacecraft for Regatta project N92-14102
History of EPOS air-launched spaceplane project N92-14103
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JPRS report: Science and technology. USSR: Life sciences
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[JPRS-ULS-91-024] N92-14582
JPRS report: Science and technology. USSR: Physics and mathematics
[JPRS-UPM-91-007] N92-14776
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K

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Evaluation of rotordynamic coefficients of look-through labyrinths by means of a three volume bulk flow model N92-14356
Determination of rotordynamic coefficients for labyrinth seals and application to rotordynamic design calculations N92-14360
KAZAN STATE UNIV. (USSR).
Optimization of the heating surface shape in the contact melting problem N92-13947
KDT INDUSTRIES, INC., AUSTIN, TX.
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[AD-A241039] N92-14608
KHMELNITSKY TECHNOLOGICAL INST. (USSR).
Identification of dynamic characteristics of flexible rotors as dynamic inverse problem N92-13962
On designing for quality N92-13963
KOBE UNIV. (JAPAN).
Experiment of static and dynamic characteristics of spiral grooved seals N92-14361
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A numerical solution method for three-dimensional nonlinear free surface problems N92-14307
KYUSHU ELECTRIC POWER CO., INC., FUKUOKA (JAPAN).
Field telemetry of blade-rotor coupled torsional vibration at Matuura Power Station Number 1 unit N92-14348

L

LABORATOIRE D'HYDRODYNAMIQUE NAVALE (FRANCE).
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LASER SCIENCE, INC., AMES, IA.
Laser deposition of cubic boron nitride on electronic materials
[AD-A241126] N92-14276
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Energetics and statistics of order in alloys with application to oxide superconductors
[DE92-000851] N92-14148
Cyclic fatigue-crack propagation in ceramics: Long and small crack behavior
[DE92-000899] N92-14164
Ground wave propagation of a video pulse source, part 2
[DE92-001794] N92-14264
Solar pumping of lasers N92-14465
Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance
[DE91-018467] N92-14488
High-frequency P wave spectra from explosions and earthquakes
[DE91-018723] N92-14557
Rebels in search of champions: Envisioning the library of the future
[DE91-016606] N92-14900
LEHIGH UNIV., BETHLEHEM, PA.
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[DE92-001657] N92-14138
LEIGH INSTRUMENTS LTD., KANATA (ONTARIO).
A DME transponder system approach for convertibility, monitoring, and diagnostics N92-14022
LISAN CORP., WASHINGTON, DC.
Design and analysis techniques for MLS safety critical software N92-14017
LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CA.
A multidisciplinary approach to the development of low-cost high-performance lightwave networks N92-14209
LOS ALAMOS NATIONAL LAB., NM.
X rays generated in the interaction of subpicosecond laser pulses with solid targets
[DE92-000297] N92-14339
Discrete event simulation in an artificial intelligence environment: Some examples
[DE92-000218] N92-14686
Geomagnetic trapping and prompt detection of protons from an orbital neutral particle beam
[DE92-000659] N92-14821
High-brightness injectors for hadron colliders
[DE92-000208] N92-14826
Support of the NATO Effects Task Group by Los Alamos National Laboratory
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Intelligent Robotic Systems Study (IRSS), phase 3
[NASA-CR-184261] N92-14671
Intelligent Robotic Systems Study (IRSS), phase 4
[NASA-CR-184262] N92-14672
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[AD-A241249] N92-14035
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[DE91-018804] N92-14113
Viscometry constants for 1,4 polybutadiene in tetralin at 135C
[AD-A241843] N92-14125
Slip, twinning and transformation in Laves phases
[DE92-000764] N92-14163
The impossibility of implementing reliable communication in the face of crashes
[AD-A241291] N92-14254
Vortex response, dimensionality and fluctuations in high-T(sub c) superconductors
[AD-A241850] N92-14284
Qualification testing of a diode-laser transmitter for free-space coherent communications
[AD-A241728] N92-14335
Neural net sensor fusion
[AD-A241765] N92-14336
Static and dynamic pressure distributions in a short labyrinth seal N92-14355
Phase space navigator: Towards automating control synthesis in phase spaces for nonlinear control systems
[AD-A241160] N92-14384
Flexural deformation of the continental lithosphere
[NASA-CR-189474] N92-14555
The matching of doubly ambiguous stereograms
[AD-A241251] N92-14587
Synthesis of visual modules from examples: Learning hyperacuity
[AD-A241159] N92-14683
Predictions and observations of seafloor infrasonic noise generated by sea surface orbital motion
[AD-A241316] N92-14793
Proposed research on advanced accelerator concepts
[DE92-000824] N92-14850
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MASSACHUSETTS UNIV., AMHERST.
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A critical view on the use of K(f) in relation to notch size effect N92-14427

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[AD-A241122] N92-14574

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Turbulence measurements in a submerged jet near a free surface N92-14305
Three-dimensional, unsteady computations of nonlinear waves caused by underwater disturbances N92-14306
Vortex ring interaction with a free surface N92-14308
Drop/gas interactions in dense sprays
[AD-A241564] N92-14315
Empirical population synthesis: New directions N92-14938
Model studies of the ionosphere of Venus: Ion composition, energetics and dynamics N92-14950

MICRONAV LTD., SYDNEY (NOVA SCOTIA).
Factory acceptance test range N92-14016
MLS testing using built-in test N92-14024

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[DE91-015030] N92-14318
Mechanistic studies of the photocatalytic behavior of TiO2 particles in a photoelectrochemical slurry cell and the relevance to photodetoxification reactions N92-14448
Effect of light intensity on photocatalytic reaction N92-14449
Solar photocatalyzed process economics N92-14452
Immobilized catalysts in solar concentrators N92-14454
Surface modification technologies using concentrated solar radiation N92-14463
Photophysics and photochemistry of porphyrin systems N92-14470
Inexpensive phenol replacements from biomass: An on-going technology transfer effort N92-14476
Production potential of biochemicals from algae and other biotechnological innovations enabled by higher solar concentration N92-14478
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MOSCOW INST. OF AVIATION TECHNOLOGY (USSR).
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Inverse problems and optimal experiment design in unsteady heat transfer processes identification N92-13967

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Symmetrically-recursion operator in bi-Lagrangian theories
[DE91-623519] N92-14706
Shell potential and its application in sputtering theory
[DE91-623660] N92-14816
Space-time structure of hadron interaction
[DE91-623947] N92-14817
Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt
[DE91-623793] N92-14952
Cosmic neutron and gamma quanta detection at balloons
[DE91-638485] N92-14960
Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range greater than 10 TeV per particle
[DE91-625051] N92-14961
Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector
[DE91-625052] N92-14962

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[DE92-001605] N92-14396

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[NIKHEF-H/91-06] N92-14823
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[NIKHEF H/91-07] N92-14824

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[NASA-CR-189525] N92-14236
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[LC-91-62359] N92-14300
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[NAP-S-416] N92-14445

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[PB91-165902] N92-14272

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The ER-2 meteorological measurement system N92-14510
ATLAS: Airborne Tunable Laser Absorption Spectrometer for stratospheric trace gas measurements N92-14511
Ames ER-2 ozone measurements N92-14512
Whole air sampler N92-14513
Radiative flux measurements in the stratosphere N92-14514
Stratosphere-troposphere exchange project management N92-14515
Aircraft deployment, and airborne arctic stratospheric expedition N92-14516
Particle chemistry impactor experiment N92-14517
DC-8 mission planning N92-14521
Inelastic collision processes in ozone and their relation to atmospheric pressure broadening N92-14526
Quantitative infrared spectroscopy of minor constituents of the Earth's atmosphere N92-14527
Stratospheric dynamics N92-14537
Studies of stratospheric particulates N92-14540
Data analysis and archival N92-14551
Analysis of troposphere-stratosphere exchange N92-14552

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Climatological stratospheric modeling N92-14543

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[NASA-CP-3123] N92-14070
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Preliminary navigation accuracy analysis for the TDRSS Onboard Navigation System (TONS) experiment on EP/EUVE N92-14072
Analysis of navigation performance for the Earth Observing System (EOS) using the TDRSS Onboard Navigation System (TONS) N92-14073
Flight dynamics facility operational orbit determination support for the ocean topography experiment N92-14074
Comparison of ERBS orbit determination accuracy using batch least-squares and sequential methods N92-14075
Ionospheric refraction effects on TOPEX orbit determination accuracy using the Tracking and Data Relay Satellite System (TDRSS) N92-14082
Study of geopotential error models used in orbit determination error analysis N92-14083
Increased ephemeris accuracy using attitude-dependent aerodynamic force coefficients for inertially stabilized spacecraft N92-14084
An extended Kalman filter for spinning spacecraft attitude estimation N92-14091
Quaternion normalization in additive EKF for spacecraft attitude determination N92-14092
Thermal emission spectroscopy of the middle atmosphere N92-14502
Measurement of the solar UV flux in the stratosphere N92-14504
Ground-based lidar measurements of stratospheric ozone. The NASA/GSFC stratospheric ozone lidar trailer experiment STROZ LITE N92-14507
Measurement of the absolute solar UV irradiance and variability N92-14522
Upper atmosphere research: Reaction rate and optical measurements N92-14525
Laboratory spectroscopy in support of atmospheric measurements N92-14528
Stratosphere chemistry in a 2-D model with residual circulation N92-14533
Fast two-dimensional model N92-14534
Stratospheric General Circulation with Chemistry Model (SGCCM) N92-14538
Stratospheric Data Analysis System (STRATAN) N92-14539
Theoretical modelling and meteorological analysis for the AASE mission N92-14542
Estimating stratospheric temperature trends using satellite microwave radiances N92-14546
Analysis of stratospheric ozone, temperature, and minor constituent data N92-14547
Analysis and interpretation of variabilities in ozone and temperature fields N92-14548
Analysis of satellite data to deduce stratospheric constituents and UV spectroscopic properties of the atmosphere N92-14549
SMM mesospheric ozone measurements N92-14550
Ada and software management in NASA: Assessment and recommendations
[NASA-TM-103298] N92-14604
A thermal/nonthermal approach to solar flares
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A Navier-Stokes solution of Hull-ring wing-thruster interaction N92-14310
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Solar pumped lasers and their applications N92-14468

Infrared measurements of atmospheric constituents N92-14501
Far infrared balloon-based limb emission measurements of HO(sub x) gases in the middle atmosphere N92-14503
Collecting, analyzing and archiving of ground based infrared solar spectra obtained from several locations N92-14506
Millimeter-wave ozone measurements for the network for the detection of stratospheric change N92-14508
Retrieval methods for ground-based millimeter-wave measurements for the network for the detection of stratospheric change N92-14509
Airborne lidar stratospheric ozone and aerosol investigations N92-14518
Airborne aerosol lidar N92-14519
In situ ozone measurements for the airborne arctic stratospheric experiment N92-14520
High resolution spectroscopy to support atmospheric measurements N92-14529
Tunable far infrared studies of molecular parameters in support of stratospheric measurements N92-14530
A facility for high resolution spectroscopy: Laboratory and ground based observations in support of upper atmospheric research N92-14531
Analysis of atmospheric spectra for trace gases N92-14532
Stratospheric dynamics and transport studies N92-14535
Homogeneous and heterogeneous chemistry along air parcel trajectories N92-14541
Analysis of observations of the middle atmosphere from satellites N92-14545
Upper Atmosphere Data Program (UADP) N92-14553
Mission and sampling analyses for atmospheric satellite experiments N92-14554
Aeroacoustics of flight vehicles: Theory and practice. Volume 2: Noise control
[NASA-RP-1258-VOL-2] N92-14779
Human response to aircraft noise N92-14780
Interior noise N92-14785
The propagation characteristics of the plate modes of acoustic emission waves in thin aluminum plates and thin graphite/epoxy composite plates and tubes
[NASA-TM-104187] N92-14790

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LEWICE/E: An Euler based ice accretion code
[NASA-TM-105389] N92-14001
Analysis of an advanced ducted propeller subsonic inlet
[NASA-TM-105393] N92-14002
On the mechanism of turbulence suppression in free shear flows under acoustic excitation
[NASA-TM-105360] N92-14003
Particle-laden weakly swirling free jets: Measurements and predictions
[NASA-TM-100881] N92-14061
The aerodynamic effect of fillet radius in a low speed compressor cascade
[NASA-TM-105347] N92-14063
High-power hydrogen arcjet performance
[NASA-TM-105143] N92-14109
Enhancing optical absorption in InP and GaAs utilizing profile etching
[NASA-TM-105325] N92-14111
Coaxial injector spray characterization using water/air as simulants
[NASA-TM-105322] N92-14112
Synergistic effects of ultraviolet radiation, thermal cycling, and atomic oxygen on altered and coated Kapton surfaces
[NASA-TM-105363] N92-14114
Computational simulation of surface waviness in graphite/epoxy woven composites due to initial curing
[NASA-TM-105313] N92-14118
Thermal conductivity and thermal expansion of graphite fiber/copper matrix composites
[NASA-TM-105233] N92-14120
Microfracture in high temperature metal matrix laminates
[NASA-TM-105189] N92-14122
Properties of novel CVD graphite fibers and their bromine intercalation compounds
[NASA-TM-105295] N92-14170
The chemistry of Saudi Arabian sand: A deposition problem on helicopter turbine airfoils
[NASA-TM-105234] N92-14179
Space Communications Technology Conference: Onboard Processing and Switching
[NASA-CP-3132] N92-14202
Destination directed packet switch architecture for a 30/20 GHz FDMA/TDM geostationary communication satellite network N92-14204
An overview of Space Communication Artificial Intelligence for Link Evaluation Terminal (SCAILET) Project N92-14212
GTEX: An expert system for diagnosing faults in satellite ground stations N92-14215
FIDEX: An expert system for satellite diagnostics N92-14218
On-board congestion control for satellite packet switching networks N92-14228
Flexible digital modulation and coding synthesis for satellite communications N92-14235
Multi-megawatt inverter/converter technology for space power applications
[NASA-TM-105307] N92-14294
Stable localized patterns in thin liquid films
[NASA-TM-105352] N92-14322
Self-pressurization of a spherical liquid hydrogen storage tank in a microgravity environment
[NASA-TM-105372] N92-14323
Rotordynamic Instability Problems in High-Performance Turbomachinery, 1990
[NASA-CP-3122] N92-14346
An evaluation of strain measuring devices for ceramic composites
[NASA-TM-105337] N92-14433
On the thermodynamic framework of generalized coupled thermoelastic-viscoplastic-damage modeling
[NASA-TM-105349] N92-14434
Thermochemical energy storage for a lunar base
[NASA-TM-105333] N92-14485
Measurement of trace stratospheric constituents with a balloon borne laser radar N92-14500
MisTec: A software application for supporting space exploration scenario options and technology development analysis and planning
[NASA-TM-105214] N92-14649
Computation of supersonic jet mixing noise for an axisymmetric CD nozzle using k-epsilon turbulence model
[NASA-TM-105338] N92-14795
A survey of the broadband shock associated noise prediction methods
[NASA-TM-105365] N92-14797
Overview of Ka-band communications technology requirements for the space exploration initiative
[NASA-TM-105308] N92-14953

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, AL.

Computational determination of ballistic limits for a simple Whipple bumper shield
[NASA-TM-105455] N92-14104
Experimental and numerical simulations of orbital debris impact on a simple Whipple bumper shield
[NASA-TM-105456] N92-14105
Limit cycle vibrations in turbomachinery
[NASA-TP-3181] N92-14108
The effects of multiple repairs on Inconel 718 weld mechanical properties
[NASA-TM-103559] N92-14380
Stratospheric constituent distributions from balloon-based limb thermal emission measurements N92-14505
Upper atmosphere dynamics N92-14544
NASA Marshall Space Flight Center solar observatory report, January - June 1991
[NASA-TM-103555] N92-14958

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. WALLOPS FLIGHT FACILITY, WALLOPS ISLAND, VA.

Rocket temperature soundings N92-14523
Balloon-borne measurements of polar stratospheric ozone N92-14524

NATIONAL AEROSPACE LAB., AMSTERDAM (NETHERLANDS).

Review of aerodynamic design in the Netherlands N92-13929

NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NC.

US Navy regional climatic study of the Barents Sea and adjacent waters
[AD-A241115] N92-14566

NATIONAL INST. FOR FUSION SCIENCE, NAGOYA (JAPAN).

Conceptual design of D-He-3 FRC reactor ARTEMIS
[NIFS-101] N92-14844

NATIONAL INST. OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MD.

Chemical processes during incineration and implications of detoxification of hazardous wastes using solar photons N92-14458
The Marr and Albus theories of the cerebellum: Two eary models of associative memory N92-14696
Publications of the National Institute of Standards and Technology, 1990 catalog
[PB91-216531] N92-14895

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO.

The second front range lidar, aircraft, and balloon experiment
[PB91-205567] N92-14564

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC.

Water vapor imagery: Interpretation and applications to weather analysis and forecasting
[NOAA-TR-NESDIS-57] N92-14565

NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).

A review of ECSC-funded research on mould powders
[NPL-DMM(A)-10] N92-14167

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).

A hard real-time operating system for airborne scientific experiments N92-14031
Rub induced rotor/stator vibration analysis on CF700 engine
[NRC-TR-ENG-007] N92-14060
Atmospheric propagation N92-14781

NATIONAL SCIENCE FOUNDATION, WASHINGTON, DC.

Antarctic news clips, 1991
[NSF-91-79] N92-14561
Summary of awards, fiscal year 1990
[NSF-90-132] N92-14602
International Science and Technology Insight, Volume 3, Number 1
[NSF-91-14] N92-14934

NATIONAL TECHNICAL UNIV., ATHENS (GREECE).

An inverse inviscid method for the design of quasi-three dimensional rotating turbomachinery cascades N92-13942

NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON, DC.

Aircraft accident report: Northwest Airlines, Inc., Flights 1482 and 299. Runway incursion and collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan, December 3, 1990
[PB91-910405] N92-14006

NAVAL OBSERVATORY, WASHINGTON, DC.

Improved accuracies for satellite tracking N92-14086

NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER, SAN DIEGO, CA.

Human-computer interfaces for tactical decision making, analysis, and assessment using artificially intelligent platforms. Volume 1: Software design and database descriptions for BATMAN and ROBIN
[AD-A241509] N92-14685

NEBRASKA UNIV., LINCOLN.

First principles theoretical studies of ferroelectric lattice instabilities
[AD-A241185] N92-14865

NEVADA UNIV., RENO.

Numerical investigations in three-dimensional internal flows
[NASA-CR-189467] N92-14313

NEWCASTLE POLYTECHNIC, NEWCASTLE-UPON-TYNE (ENGLAND).

The application of a cylindrical-spherical floating ring bearing as a device to control stability of turbogenerators N92-14371

NEWCASTLE-UPON-TYNE UNIV. (ENGLAND).

Effect of viscous damping on the response of floating bodies N92-14303

NORTH CAROLINA UNIV., CHAPEL HILL.

Chemical models of advanced oxidation processes N92-14447

NORTHWEST RESEARCH ASSOCIATES, INC., BELLEVUE, WA.

Report on the search for atmospheric holes using airs image data
[NASA-CR-187902] N92-14943

NORTHWESTERN POLYTECHNICAL UNIV., XIAN (CHINA).

The stability of the steady state and bistable response of a flexible rotor supported on squeeze film dampers N92-14350

NORTHWESTERN UNIV., EVANSTON, IL.

Study of mechanical behavior and internal structure of ferritic nanocrystalline material
[DE92-000760] N92-14162

NULITE, LONDON (ONTARIO).

Photocatalyzed removal of multiple contaminants from water N92-14453

O

OAK RIDGE NATIONAL LAB., TN.
Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry
[DE91-018610] N92-14127
Grain boundary fracture and alloy design of intermetallics
[DE91-018253] N92-14145
Use of miniature and standard specimens to evaluate effects of irradiation temperature on pressure vessel steels
[DE91-018849] N92-14154
The ultimate ethanol: Technoeconomic evaluation of ethanol manufacture, comparing yeast vs (ital Zymomonas) bacterium fermentations
[DE92-000402] N92-14185
Numerical modelling of the TFTR ICRH antennas
[DE92-002061] N92-14265
ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions
[DE91-017690] N92-14387
OFFICE OF TECHNOLOGY ASSESSMENT, WASHINGTON, DC.
New Ways: Tiltrotor aircraft and magnetically levitated vehicles
[OTA-SET-507] N92-14933
OHIO STATE UNIV., COLUMBUS.
Structural damage identification using mathematical optimization techniques N92-13936
Video data compression using artificial neural network differential vector quantization N92-14214
Method of moments analysis of scattering by chiral media
[AD-A241848] N92-14257
SATCOM antenna siting study on P-3C aircraft, volume 1
[NASA-CR-189514] N92-14262
SATCOM antenna siting study on P-3C aircraft, volume 2
[NASA-CR-189515] N92-14263
OLD DOMINION UNIV., NORFOLK, VA.
Morphology and microstructure of composite materials
[NASA-CR-189473] N92-14117
Theoretical studies of lasers and converters
[NASA-CR-189482] N92-14333
Integrated adaptive filtering and design for control experiments of flexible structures
[NASA-CR-188627] N92-14390
OREGON UNIV., EUGENE.
High temperature electronic excitation and ionization rates in gases
[NASA-CR-189496] N92-14801

P

PACIFIC NORTHWEST LAB., RICHLAND, WA.
PEGASUS: An integrated power and propulsion system for the space exploration initiative
[DE92-000145] N92-14107
Testing of advanced ceramic fabric heat pipe for a Stirling engine
[DE92-000142] N92-14174
Acoustic emission from stress corrosion crack initiation and growth in Type 304 SS
[DE91-018827] N92-14395
Influences of clouds and rain on the large-scale transport and deposition of sulfur
[DE92-000473] N92-14492
PAKISTAN INST. OF NUCLEAR SCIENCE AND TECHNOLOGY, ISLAMABAD.
Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: A molecular dynamics study
[DE91-623616] N92-14131
Steady reactive state in an irreversible reaction
[DE91-624220] N92-14132
Segregation in welded nickel-base alloys
[DE91-624373] N92-14158
PASTERNAK (ALAN D.), LAFAYETTE, CA.
Waste treatment N92-14456
PAUL SCHERRER INST., VILLIGEN (SWITZERLAND).
Status of European research and development in solar chemistry and industrial interest in this technology N92-14479
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Third International Conference on Inverse Design Concepts and Optimization in Engineering Sciences (ICIDES-3)
[NASA-CR-188125] N92-13928
Aerodynamic shape optimization of arbitrary hypersonic vehicles N92-13954
Analysis and design of planar and non-planar wings for induced drag minimization
[NASA-CR-189509] N92-13999
PENNSYLVANIA UNIV., PHILADELPHIA.
Polymeric electrolytes for ambient temperature lithium batteries
[DE92-000711] N92-14289
PHILLIPS LAB., KIRKLAND AFB, NM.
Ionizing radiation survey
[AD-A240966] N92-14253
PLANNING AND MANAGEMENT CONSULTANTS LTD., CARBONDALE, IL.
Reducing environmental noise impacts: A USAREUR noise management program handbook
[AD-A240797] N92-14791
POLITECNICO DI MILANO (ITALY).
Definition of reusable concurrent software components
[REPT-90-066] N92-14606
PRAIRIE VIEW AGRICULTURAL AND MECHANICAL COLL., TX.
Flow boiling with enhancement devices for cold plate coolant channel design
[NASA-CR-189518] N92-14892
PURDUE UNIV., WEST LAFAYETTE, IN.
Asynchronous optical sampling for laser-based combustion diagnostics in high-pressure flames
[AD-A241640] N92-14133
Applications of real-time FTIR spectroscopy to the elucidation of complex electroorganic pathways: Electrooxidation of ethylene glycol on platinum, gold, and nickel in alkaline solution
[AD-A241797] N92-14282
Annual Research Summary, 1 July 1990 to 30 June 1991 N92-14964

Q

QUEENS UNIV., KINGSTON (ONTARIO).
Coherent detection of interleaved trellis encoded CPFSK for shadowed mobile satellite channels N92-14030

R

RANGE COMMANDERS COUNCIL, WHITE SANDS MISSILE RANGE, NM.
General principles of digital filtering and a survey of filters in current range use
[AD-A240984] N92-14274
RENSSELAER POLYTECHNIC INST., TROY, NY.
Electrical impedance imaging in two-phase, gas-liquid flows: 1. Initial investigation N92-13937
REPUBLIC ELECTRONICS CO., HAUPPAUGE, NY.
Validation testing of DME/P ground transponders and airborne interrogators N92-14021
RESEARCH INST. FOR ADVANCED COMPUTER SCIENCE, MOFFETT FIELD, CA.
Temporal learning in the cerebellum: The microcircuit model
[NASA-CR-188873] N92-14668
Cerebellar models of associative memory: Three papers from IEEE COMPCON spring 1989
[NASA-CR-188838] N92-14694
A cerebellar-model associative memory as a generalized random-access memory N92-14695
Evaluating the operations capability of Freedom's Data Management System
[NASA-CR-187315] N92-14894
RHODE ISLAND UNIV., KINGSTON.
PEM-West trajectory climatology and photochemical model sensitivity study prepared using retrospective meteorological data
[NASA-CR-188128] N92-14572
ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA.
Suppression of subsynchronous vibration in the SSME HPFTP N92-14359
The Rocketdyne multifunction tester. Part 1: Test method N92-14368
The Rocketdyne Multifunction Tester. Part 2: Operation of a radial magnetic bearing as an excitation source N92-14369
Airfoil Vibration Dampers program
[NASA-CR-188929] N92-14391
Composite load spectra for select space propulsion structural components
[NASA-CR-189078] N92-14435
ROCKWELL INTERNATIONAL CORP., THOUSAND OAKS, CA.
Theoretical and experimental investigation of heterojunction interfaces
[AD-A241243] N92-14278
ROCKWELL SPACE OPERATIONS CO., HOUSTON, TX.
Navigation of the TSS-1 mission N92-14076
Testing of the high accuracy inertial navigation system in the Shuttle Avionics Integration Lab N92-14087
ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, NY.
Architecture for Survivable System Processing (ASSP) N92-14210
ROME LAB., GRIFFISS AFB, NY.
Adaptive optical processor
[AD-A241535] N92-14837
ROYAL AEROSPACE ESTABLISHMENT, FARNBOROUGH (ENGLAND).
Lightning protection requirements for aircraft: A proposed specification
[RAE-TM-FS(F)-632-REV-ISSUE-1] N92-14007
Specimens for fatigue and fracture evaluation of metals: FRAG recommendations (first issue)
[RAE-TR-91025] N92-14166
Predictions and measurements of 3D viscous flow in a transonic turbine nozzle guide vane row
[RAE-TM-P-1205] N92-14319
ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
Flux-profile relationships in the nocturnal boundary layer
[KNMI-TR-130] N92-14570
The implementation of the WAQUA/CSM-16 model for real time storm surge forecasting
[KNMI-TR-131] N92-14575
ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN (ENGLAND).
Analysis of the Space Shuttle cabin radiation environment. Part 1: SAM gamma radiation detector results
[RAE-TM-SPACE-383-PT-1] N92-14099
A review of positive ion sensitivities for the SIMS analysis of CMT
[RSRE-91015] N92-14139
Electromagnetic scattering by the delta boundary operator method
[RSRE-MEMO-4502] N92-14267
TDF: Specification of subset to support ANSI C, C++, FORTRAN 77, COBOL and Pascal
[RSRE-91014] N92-14624
Traceability and conformance in secure systems
[RSRE-91016] N92-14625
Secure refinement
[RSRE-91019] N92-14626
An example machine used for developing a proof strategy for secure systems
[RSRE-91022] N92-14627
Practical computational complexity
[RSRE-MEMO-4468] N92-14628
A bi-directional BAUDOT/ASCII code converter
[RSRE-MEMO-4479] N92-14629
Notes on the polyinstantiation problem
[RSRE-MEMO-4504] N92-14630
Lies, damned lies, and databases
[RSRE-MEMO-4503] N92-14917

S

SANDIA NATIONAL LABS., ALBUQUERQUE, NM.
Auger spectroscopy and electronically-stimulated surface processes
[DE92-000950] N92-14137
High temperature nitrogen implantation of Ti-6Al-4V
[DE91-018678] N92-14153
Fundamentals of metals joining with lasers
[DE92-000789] N92-14156
The effect of Cu at Al grain boundaries on electromigration behavior in Al thin films
[DE91-018677] N92-14159
Sequential deposition etch techniques for the selective deposition of tungsten
[DE92-000953] N92-14165
Preoxidation cleaning optimization for crystalline silicon
[DE92-000981] N92-14178
SNL initiatives in electronic fluxless soldering
[DE92-000818] N92-14188
Transfer impedance of coaxial cables
[DE91-018411] N92-14273
Characteristics and development report for the MC3246A thermal battery
[DE92-000609] N92-14288
The environmentally safe battery
[DE92-001715] N92-14293
Hypervelocity launch capabilities to over 10 km/s
[DE92-000242] N92-14377
Phased-array antenna control by a monolithic photonic integrated circuit, COMPASS
[DE92-000998] N92-14378
A chaotic system for the generation of extreme mechanical environments
[DE91-018358] N92-14388

Photocatalysis with large-scale trough collectors N92-14455
A comparison of the economics of materials processing with solar furnaces and high-intensity arc lamps N92-14464
Design of the support structure, drive pedestal, and controls for a solar concentrator
[DE92-000604] N92-14483
Improved selection in totally monotone arrays
[DE92-000817] N92-14610
Shock wave codes at Sandia National Laboratories
[DE91-017847] N92-14612
Two-dimensional adaptive enhancement and detection of linear features in noisy images
[DE92-000982] N92-14613
Converting a commercial electric direct-drive robot to operate from joint torque commands
[DE92-000611] N92-14687
Interfering optical interactions: Phase sensitive absorption
[DE92-000795] N92-14842
Electrical characterization of RF plasmas
[DE92-000822] N92-14863
Triggering GaAs lock-on switches with laser diode arrays
[DE90-013400] N92-14864

SCIENCE APPLICATIONS INTERNATIONAL CORP., LA JOLLA, CA.
A numerical study of three-dimensional viscous interactions of vortices with a free surface N92-14311

SCIENCE APPLICATIONS INTERNATIONAL CORP., SAN DIEGO, CA.
Determination of the coronal magnetic field from vector magnetograph data
[NASA-CR-185477] N92-14957

SCIENTIFIC RESEARCH ASSOCIATES, INC., GLASTONBURY, CT.
Optimization of transistor design including large signal device/circuit interactions at extremely high frequencies (20-100+GHz) N92-13972

SHANGHAI INST. OF MECHANICAL ENGINEERING (CHINA).
Research on inverse, hybrid and optimization problems in engineering sciences with emphasis on turbomachine aerodynamics: Review of Chinese advances N92-13939
Variational formulation of hybrid problems for fully 3-D transonic flow with shocks in rotor N92-13953

SKOE (IVAR HELGE), KONGSBERG (NORWAY).
A PC-based inverse design method for radial and mixed flow turbomachinery N92-13943

SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MA.
An astrophysics data program investigation of a synoptic study of quasar continua
[NASA-CR-189003] N92-14939

SOCIETE FRANCO-AMERICAINE DE CONSTRUCTIONS ATOMIQUES, COURBEVOIRE (FRANCE).
Predictions of fatigue crack initiation from defects in welded and cast components N92-14426

SOCIETE NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION, CINCINNATI, OH.
Recent progress in inverse methods in France N92-13938

SOUTHAMPTON UNIV. (ENGLAND).
The effects of manufacturing tolerances on the vibration of aero-engine rotor-damper assemblies N92-14349

SOUTHERN METHODIST UNIV., DALLAS, TX.
Gravity and topography of Venusian highlands: Implications for formation mechanisms N92-14948

SOUTHWEST RESEARCH INST., SAN ANTONIO, TX.
Physiological response of birds to approaching aircraft
[DOT/FAA/CT-91/14] N92-14008
Fluid management technology: Liquid slosh dynamics and control
[NASA-CR-189107] N92-14320
A simulation study of interactions of space-shuttle generated electron beams with ambient plasma and neutral gas
[NASA-CR-189019] N92-14846

SPACE SYSTEMS/LORAL, PALO ALTO, CA.
Mobile telephony through LEO satellites: To OBP or not N92-14206

SPACE TELESCOPE SCIENCE INST., BALTIMORE, MD.
An analysis of the Hubble Space Telescope fine guidance sensor fine lock mode N92-14089

SPECTRA RESEARCH SYSTEMS, INC., HUNTSVILLE, AL.
Evaluation of advanced propulsion options for the next manned transportation system: Propulsion evolution study
[NASA-CR-184204] N92-14106
Initial assessments of life support technology evolution and advanced sensor requirements, volume 2, appendix A
[NASA-CR-184248] N92-14591
Appendices B thru F, volume 3
[NASA-CR-184249] N92-14592
Advanced instrumentation: Technology database enhancement, volume 4, appendix G
[NASA-CR-184250] N92-14593
Clean room survey and assessment, volume 5, appendix H
[NASA-CR-184251] N92-14594
Advanced life support study
[NASA-CR-184247] N92-14595

ST SYSTEMS CORP., LANHAM, MD.
COBE ground segment attitude determination N92-14079
COBE ground segment gyro calibration N92-14080

STANFORD LINEAR ACCELERATOR CENTER, CA.
Field calculation algorithm for general beam distributions
[DE92-002017] N92-14836
Discrete anti-gravity
[DE91-011756] N92-14878

STANFORD TELECOMMUNICATIONS, INC., RESTON, VA.
A Code Phase Division Multiple Access (CPDMA) technique for VSAT satellite communications N92-14205

STANFORD UNIV., CA.
Materials processing and synthesis N92-14460
First coincidence experiments between cryogenic resonant-mass gravitational wave detectors, 1. Development of a thin film superconducting transducer for a gravitational wave antenna, 2 N92-14497

STATE UNIV. OF NEW YORK, ALBANY.
Maintenance of a rural precipitation chemistry center at Whiteface Mountain
[DE92-000033] N92-14487

STATE UNIV. OF NEW YORK, BINGHAMTON.
Photchemistry of intermolecular C-H bond activation reactions
[DE91-018967] N92-14130

STATE UNIV. OF NEW YORK, BUFFALO.
Correlation techniques to determine model form in robust nonlinear system realization/identification N92-14094
Reynolds stress model predictions of supersonic turbulent boundary layer flow over compression surfaces N92-14298

STATE UNIV. OF NEW YORK, STONY BROOK.
Rational approximations to fluid properties
[DE90-012531] N92-14297

STRATEGIC DEFENSE INITIATIVE ORGANIZATION, WASHINGTON, DC.
ZEST flight test experiments, Kauai Test Facility, Hawaii
[AD-A241143] N92-14764

STUTTGART UNIV. (GERMANY, F.R.).
Supercritical blade design on stream surfaces of revolution with an inverse method N92-13950
Experimental investigations of exciting forces caused by flow in labyrinth seals N92-14354

SULZER BROS. LTD., WINTERTHUR (SWITZERLAND).
Annular seals of high energy centrifugal pumps: Presentation of full scale measurement N92-14362

SVERDRUP TECHNOLOGY, INC., BROOK PARK, OH.
Analysis of lunar regolith thermal energy storage
[NASA-CR-189073] N92-14480

SYMS (RAYMOND A.) AND ASSOCIATES, BRIDGE WATER, NJ.
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033

SYSTEMS CONTROL TECHNOLOGY, INC., ARLINGTON, VA.
Operational survey: VFR heliport approaches and departures
[SCT-91RR-26] N92-14033

SYSTEMS CONTROL TECHNOLOGY, INC., PALO ALTO, CA.
Turbine engine diagnostics system study
[DOT/FAA/CT-91/16] N92-14064

T

TECHNICAL RESEARCH CENTRE OF FINLAND, ESPOO.
Underwater Technology Symposium
[VTT-120] N92-14190
Motion dynamics of submersibles N92-14191
Hydroacoustic transmission of video image for the control of a Remotely Operated undersea Vehicle (ROV) N92-14192
Energy source possibilities in underwater technics N92-14193
Materials behaviour in the deep sea environments N92-14195
Development of a calibration method for deepsea magnetic particle testing N92-14196
Testing a force sensor for underwater magnetic particle inspection N92-14197

TECHNICAL RESEARCH CENTRE OF FINLAND, HELSINKI.
Dynamics of risers N92-14200

TECHNICAL RESEARCH CENTRE OF FINLAND, OULU.
Optical proximity sensor for underwater manipulator applications N92-14199

TECHNICAL RESEARCH CENTRE OF FINLAND, TAMPERE.
Pressure chamber for simulation of deep sea conditions N92-14194
Tool exchanger for underwater use N92-14198

TECHNISCHE UNIV., CLAUSTHAL-ZELLERFELD (GERMANY, F.R.).
Multiaxial fatigue under constant and variable amplitude loading N92-14401
The effect of overloads on life-time N92-14430

TECHNISCHE UNIV., DELFT (NETHERLANDS).
LDA measurements in the highly asymmetric trailing edge flow of an NLR 7702 airfoil
[LR-646] N92-14004
The two-bay crack problem in fuselages built in GLARE and ARALL
[LR-653] N92-14044
Bulging of fatigue cracks in a pressurized aircraft fuselage
[LR-655] N92-14045
GPS: Satellite orbits and atmospheric effects
[REPT-91-1] N92-14097
Inclination functions: Group theoretical background and a recursive algorithm
[REPT-91-2] N92-14115
The deformation modes of continuous fibre reinforcements in thermoplastic composites during thermoforming: A preliminary hierarchy and geometrical description
[LR-654] N92-14123
A multigrid method for an invariant formulation of the incompressible Navier-Stokes equations in general coordinates
[REPT-91-12] N92-14321
On a doubly degenerate equation arising in fresh-salt water flow with pumping
[REPT-91-30] N92-14324
Numerical evaluation of an effective Roe scheme and chemical models for chemically reacting nozzle flows in thermal equilibrium
[LR-623] N92-14325
Numerical evaluation of an efficient Roe-type flux difference scheme for thermochemical non-equilibrium nozzle flows
[LR-624] N92-14326
Input mobilities and power flows for edge-excited, semi-infinite plates
[REPT-91-19] N92-14437
Monitoring sea level rise
[REPT-90-1] N92-14576
Next generation authoring systems: Integration of multiple methodologies and tools
[REPT-90-80] N92-14601
Constructive fixpoint semantics for truth maintenance systems
[REPT-90-85] N92-14641
Constructive identification with Poole's default logic
[REPT-90-86] N92-14642
A fast parallel Earley bottom up recognizer
[REPT-90-88] N92-14643
Dialogue structuring
[REPT-90-89] N92-14644
A CSG scanline algorithm for quadrics
[REPT-90-90] N92-14645
Algorithms for the correct implementation of scheduling policies in distributed systems
[REPT-90-91] N92-14646
A comparison of some quick algorithms for robust regression
[REPT-90-92] N92-14647
Case study of a national educational software development program: The Netherlands
[REPT-91-15] N92-14648
Efficient hybrid rendering of volume data and polygons
[REPT-91-17] N92-14650
Necessary and sufficient conditions or optimal fixed-order dynamic compensation of linear discrete-time systems
[REPT-91-14] N92-14693
Separatrix cycles and multiple limit cycles in a class of quadratic systems
[REPT-90-84] N92-14732
Generalization of traveltime inversion
[REPT-91-13] N92-14733

Positive solutions of semilinear elliptic systems
[REPT-91-16] N92-14734
On defining classes of quadratic systems in the plane
[REPT-91-32] N92-14735
Second order wave forces and wave drift damping
[REPT-91-34] N92-14736
On the zeros of orthogonal polynomials in a discrete Sobolev space with a symmetric inner product
[REPT-91-35] N92-14737
The Grenander estimator of a monotone density: Basic facts
[REPT-91-01] N92-14757
Scale sensitivity and rank preservation in a multiplicative variant of the analytic hierarchy process
[REPT-91-20] N92-14758
On the sum of two maximal monotone operators, 2
[REPT-91-31] N92-14766
Lindeloef in versus in Lindeloef
[REPT-91-23] N92-14767
Propeller-driven-small airplane noise certification
[LR-650] N92-14798
Education stimulation project COO for A30-CT
[REPT-90-87] N92-14893

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.).
Hydraulic actuator system for rotor control N92-14363

TENNESSEE UNIV., KNOXVILLE.
A study of lanthanide fluorescence shifts caused by near neighbor perturbation
[DE91-018532] N92-14804

TEXAS A&M UNIV., COLLEGE STATION.
Radiation, scattering, and guidance of electromagnetic fields by arbitrarily shaped structures embedded in layered dielectric media
[AD-A241832] N92-14256
Nonlinear rotordynamics analysis
[NASA-CR-184263] N92-14344
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 1: Fully open ended configuration N92-14352
Measurements of pressure distributions and force coefficients in a squeeze film damper. Part 2: Partially sealed configuration N92-14353
Test results for rotordynamic coefficients of the SSME HPOTP turbine interstage seal with two swirl brakes N92-14357
Seal-rotordynamic-coefficient test results for a model SSME ATD-HPFTP turbine interstage seal with and without a swirl brake N92-14358
Electromechanical simulation of actively controlled rotordynamic systems with piezoelectric actuators N92-14365
Fluid compressibility effects on the dynamic response of hydrostatic journal bearings N92-14372
Effect of eccentricity on the static and dynamic performance of a turbulent hybrid bearing N92-14373
Theoretical foundations for information representation and constraint specification
[AD-A241842] N92-14899

TEXAS UNIV., AUSTIN.
Elastic second-order computer analysis of beam-columns and frames
[AD-A241247] N92-14385
Enhancement of current diffusion in the presence of a kink mode or an Alfven wave
[DE91-018424] N92-14845

TEXTRON BELL HELICOPTER, FORT WORTH, TX.
Technology needs for high speed rotorcraft (3)
[NASA-CR-177592] N92-14039

THERMAL POWER ENGINEERING RESEARCH INST., XIAN (CHINA).
Investigation and control of rotordynamic instability in typical large turbogenerators N92-14347

THOMSON-CSF, MALAKOFF (FRANCE).
Mixed approach towards modular avionics conflicting requirements N92-14051

TITAN SYSTEMS, INC., PRINCETON, NJ.
A unified viscous theory of lift and drag of 2-D thin airfoils and 3-D thin wings
[NASA-CR-4414] N92-13997

TOKYO UNIV., SAGAMIHARA (JAPAN).
Aerodynamic aircraft design methods and their notable applications: Survey of the activity in Japan N92-13930

TOKYO UNIV., TANASHI (JAPAN).
A search for charged Higgs bosons at TRISTAN
[DE91-767869] N92-14813

TOLEDO UNIV., OH.
A reconfigurable multicarrier demodulator architecture N92-14213

TORONTO UNIV., DOWNSVIEW (ONTARIO).
Activities of the University of Toronto Institute for Aerospace Studies
[CTN-91-60222] N92-13975
Aeroacoustics N92-13976
Aerodynamics N92-13977
Combustion and propulsion N92-13978
Computational fluid dynamics N92-13979
Fiber optic smart structures N92-13980
Flight research N92-13981
Flight simulation N92-13982
Hypersonic aerodynamics N92-13983
Materials processing in space N92-13984
Nonstationary gasdynamics N92-13985
Shock waves, implosions and dusty gases N92-13986
Space robotics N92-13987
Spacecraft dynamics and control N92-13988
Structural mechanics and materials science N92-13989

TRANSPORT CANADA AVIATION, OTTAWA (ONTARIO).
The effect of error tolerances on MLS array antenna N92-14014

TRANSPORTATION DEVELOPMENT CENTRE, MONTREAL (QUEBEC).
TDC: Innovation in transport N92-14010

TRW SPACE TECHNOLOGY LABS., REDONDO BEACH, CA.
Getting expert systems off the ground: Lessons learned from integrating model-based diagnostics with prototype flight hardware N92-14217
Design, modeling, and analysis of multi-channel demultiplexer/demodulator N92-14223
Multi-rate demodulator architecture N92-14232

TSINGHUA UNIV., BEJING (CHINA).
Design of transonic compressor cascades using hodograph method N92-13973
The research progress on Hodograph Method of aerodynamic design at Tsinghua University N92-13974

U

ULTROX INTERNATIONAL, INC., SANTA ANA, CA.
Ultrox operating experiences with UV/oxidation; economics N92-14451

UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT.
High temperature static strain gage development
[NASA-CR-189044] N92-14037

UNIVERSITEIT TWENTE, ENSCHEDE (NETHERLANDS).
A multi-media multi-user service for the B-ISDN
[MEMO-INF-91-56] N92-14266
Modeling and feedback control of a flexible arm of a robot for prescribed frequency-domain tolerances
[MEMO-973] N92-14379
An engineering approach to ODP systems design
[MEMO-INF-91-49] N92-14600
A last-fit greedy coloring algorithm for interval graphs
[MEMO-961] N92-14615
Scattered data interpolation by bivariate quadratic and cubic splines: Description of programs
[MEMO-977] N92-14616
A hyperelliptic diophantine equation related to imaginary quadratic number fields with class number 2
[MEMO-978] N92-14617
Compiler generator library reference manual
[MEMO-INF-91-08] N92-14618
Algorithms for topological partitioning of programmed logic arrays, under floorplan, and delay constraints
[MEMO-INF-91-43] N92-14619
Bundle event structures: A non-interleaving semantics for LOTOS
[MEMO-INF-91-60] N92-14620
Increasing the efficiency of an algorithm for solving the problem M(Y,G)
[MEMO-922] N92-14632
Joining distributed complex objects: Definition and performance
[MEMO-INF-91-35] N92-14633
Focusing based on the structure of a model-based diagnosis
[MEMO-INF-91-41] N92-14634
Event structures for design and transformation in LOTOS
[MEMO-INF-91-45] N92-14635
An exercise in protocol synthesis
[MEMO-INF-91-46] N92-14636
Symbolic execution of LOTOS specifications
[MEMO-INF-91-47] N92-14637
Addressing performance requirements in the FDT based design of distributed systems
[MEMO-INF-91-48] N92-14638
Composite performance and dependability analysis
[MEMO-INF-91-50] N92-14639
Geographic data modelling in TM
[MEMO-INF-91-53] N92-14640
Polynomial-time transformations and schedulability analysis of parallel real-time programs with restricted resource contention
[MEMO-INF-91-55] N92-14665
Dynamic action scheduling in a parallel database system
[MEMO-INF-91-58] N92-14666
Minimality of dynamic input-output decoupling for nonlinear systems
[MEMO-960] N92-14688
L2-gain analysis of nonlinear systems and nonlinear H infinity control
[MEMO-969] N92-14689
Relations between (H infinity) optimal control of a nonlinear system and its linearization
[MEMO-970] N92-14690
Super-optimization of four-block problems via the equalizer principle
[MEMO-957] N92-14691
Adaptive PD+ control of rigid robot manipulators
[MEMO-958] N92-14692
The connectivity of the leaf-exchange spanning tree graph of a graph
[MEMO-959] N92-14711
Conceptual data models versus knowledge graphs
[MEMO-962] N92-14712
Degenerate polynomial patches of degree 4 and 5 used for geometrically smooth interpolation in R3
[MEMO-963] N92-14713
Stoermer-Cowell- and related methods for the numerical solution of second order periodic initial value problems for ODE's. 1: Survey of methods
[MEMO-966] N92-14714
On the symbolic calculation of periodic orbits for the logistic map
[MEMO-965] N92-14715
On approximation and interpolation of convex functions
[MEMO-967] N92-14716
A note on maximal spanning tree games and Prim's algorithm
[MEMO-968] N92-14717
Generalizing multiquadratic interpolation: Univariate case
[MEMO-974] N92-14718
Derivative generation in piecewise cubic C(1)-interpolation
[MEMO-976] N92-14719
An improved approach to automatic error cumulation control
[MEMO-INF-91-61] N92-14720
Further results in the triangular decoupling problem for nonlinear systems
[MEMO-941] N92-14724
On radial spline interpolation
[MEMO-948] N92-14725
N-dimensional line digraphs
[MEMO-949] N92-14726
Minimum basis graphs of weighted matroids
[MEMO-950] N92-14727
Hard graphs for the maximum clique problem 2
[MEMO-951] N92-14728
Homomorphisms on n-dimensional line digraphs
[MEMO-952] N92-14729
Fourier transformation in an algebra of generalized functions
[MEMO-954] N92-14730
A singular nonlinear Volterra integral equation
[MEMO-955] N92-14731
A continuous polling system with general service times
[MEMO-971] N92-14750
The batch-arrival bulk-service queue with Poisson arrivals
[MEMO-972] N92-14751
Equivalence of nonlinear systems to input-output prime forms
[MEMO-975] N92-14752
A framework for test selection
[MEMO-INF-91-54] N92-14753
Approximate performability analysis using generalized stochastic Petri nets
[MEMO-INF-91-40] N92-14755
Post's system of tag: A simple discrete nonlinear system
[MEMO-INF-91-44] N92-14756
Object-Oriented Data Base (OODB) concepts
[MEMO-INF-91-42] N92-14918

UNIVERSITY OF SOUTH AUSTRALIA, POORAKA.
A bandwidth efficient coding scheme for the Hubble Space Telescope N92-14211

UNIVERSITY OF SOUTH FLORIDA, TAMPA.
Stability of intershaft squeeze film dampers N92-14351

USTAV JADERNEHO VYZUMU, REZ (CZECHOSLOVAKIA).
Constitutive equations for polycrystalline void-containing materials and initiation of shear fracture
[DE91-638175] N92-14389

UTAH STATE UNIV., LOGAN.
Data analysis and interpretation related to space system/environment interactions at LEO altitude
[NASA-CR-189524] N92-14186
A study of the relationship between ionospheric oscillations and geomagnetic pulsations N92-14495
The flow of plasma in the solar terrestrial environment
[NASA-CR-188812] N92-14955
UTRECHT STATE UNIV. (NETHERLANDS).
Stepwise refinement of reactive processor farms
[RUU-CS-91-17] N92-14271
Evaluation of the Cedar memory system: Configuration of 16 by 16
[NASA-CR-189535] N92-14603
A fully abstract model for concurrent constraint programming
[RUU-CS-91-10] N92-14651
Preliminary basic performance analysis of the Cedar multiprocessor memory system
[NASA-CR-189542] N92-14652
Termination of term rewriting: From many-sorted to one-sorted
[RUU-CS-91-18] N92-14653
Embedding as a tool for language comparison: On the CSP hierarchy
[RUU-CS-91-24] N92-14654
Network orientation
[RUU-CS-91-8] N92-14667
Some domination problems on trees and on general graphs
[RUU-CS-91-22] N92-14745
Planar graph augmentation problems
[RUU-CS-91-25] N92-14746
Minimum-link c-oriented path queries
[RUU-CS-91-27] N92-14747
The optimal placement of replicated items in distributed databases on tree-like networks
[RUU-CS-91-23] N92-14762
Point location in zones of k-flats in arrangements
[RUU-CS-91-9] N92-14769
Cautious backtracking and well-founded semantics in truth maintenance systems
[RUU-CS-91-26] N92-14919

V

VIRGINIA COMMONWEALTH UNIV., RICHMOND.
Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data
[DE91-018528] N92-14128
VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Design optimization of transonic airfoils N92-13961
The flow past wing-body junction: An experimental evaluation of turbulence models N92-14312
VIRGINIA UNIV., CHARLOTTESVILLE.
Dynamic characteristics and stability analysis of space shuttle main engine oxygen pump N92-14366
Emission processes and dynamics of hot gases in astrophysics
[NASA-CR-189465] N92-14944
VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).
Blade design and analysis using a modified Euler solver N92-13952
An application of conformal mappings to general grid generation and potential flow problems
[VKI-TN-175] N92-14327
Numerical simulation of spatially developing forced and natural mixing layers with Large Eddy Simulation (LES)
[VKI-TN-176] N92-14328
Modelling of turbulent heat transport: A state-of-the-art
[VKI-TM-47] N92-14329

W

WARSAW TECHNICAL UNIV. (POLAND).
Design of 3-dimensional complex airplane configurations with specified pressure distribution via optimization N92-13948
WASHINGTON UNIV., SAINT LOUIS, MO.
Hierarchic models for laminated plates
[NASA-CR-187827] N92-14121
WASHINGTON UNIV., SEATTLE.
Blackbody pumped lasers N92-14467
Retrieval of pressure, temperature and cloud structure in frontal rainbands N92-14563
Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions
[DE92-000825] N92-14814
WEIZMANN INST. OF SCIENCE, REHOVOTH (ISRAEL).
Chemical reactions driven by concentrated solar energy N92-14475
The biotechnology of cultivating Dunaliella rich in beta carotene: From basic research to industrial production N92-14477
WEST VIRGINIA UNIV., MORGANTOWN.
The effects of winglets on low aspect ratio wings at supersonic Mach numbers
[NASA-CR-4407] N92-13996
WESTINGHOUSE ELECTRIC CORP., BALTIMORE, MD.
Implications of interoperability and standardization for the industrial base N92-14057
Optimization of an optically implemented on-board FDMA demultiplexer N92-14222
WESTINGHOUSE HANFORD CO., RICHLAND, WA.
CDFTBL: A statistical program for generating cumulative distribution functions from data
[DE92-002106] N92-14614
Justification for reporting negative value counting results as an alternative to minimum detectable activity
[DE91-018165] N92-14803
WG ASSOCIATES, DALLAS, TX.
Design of the support structure, drive pedestal, and controls for a solar concentrator
[DE92-000604] N92-14483
WINDSOR UNIV. (ONTARIO).
Analysis and design of transonic airfoils using streamwise coordinates N92-13955
WISCONSIN UNIV., MADISON.
High spectral resolution measurements for the ARM Program
[DE92-000765] N92-14493
WRIGHT LAB., WRIGHT-PATTERSON AFB, OH.
Proceedings of Damping 1991, volume 3
[AD-A241313] N92-14386
WRIGHT STATE UNIV., DAYTON, OH.
Pharmacological and neurophysiological aspects of space/motion sickness
[NASA-CR-189521] N92-14586

X

XIAN JIAOTONG UNIV. (CHINA).
A new method of optimal design for a two-dimensional diffuser by using dynamic programming N92-13968
Study of a new airfoil used in reversible axial fans N92-13970

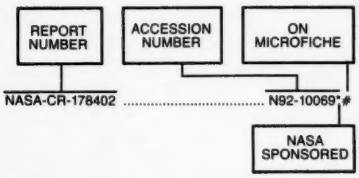
Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The accession number denotes the number by which the citation is identified.

AF PROJ. DC9-7-EW N92-14331
AF PROJ. 2301 ..... N92-14802
AF PROJ. 2308 ..... N92-14133
N92-14315
AF PROJ. 2401 ..... N92-14386
AF PROJ. 4506 ..... N92-14255
AF PROJ. 5797 ..... N92-14253
AF-AFOSR-0051-89 ..... N92-14133
AF-AFOSR-0426-89 ..... N92-14802
AF-AFOSR-0516-89 ..... N92-14315
BMFT-07431018 ..... N92-14573
CNT PROJ. 6902 ..... N92-14009
N92-14018
DA PROJ. 2Q1-62785-A-790 ..... N92-14597
DA PROJ. 2Q2-63007-A-792 ..... N92-14597
DA PROJ. 4A1-61102-AT-24 ..... N92-14440
DA PROJ. 4A7-62784-AT-42 ..... N92-14440
DAAB07-86-C-F114 ..... N92-14277
DAAL04-87-C-0083 ..... N92-14171
DACA76-85-C-0010 ..... N92-14587
N92-14683
DAJA45-90-C-0023 ..... N92-14181
DASG60-89-C-0142 ..... N92-14657
N92-14658
N92-14659
N92-14660
N92-14661
N92-14662
N92-14663
N92-14664
DE-AC02-76CH-00016 ..... N92-14799
DE-AC02-76CH-03000 ..... N92-14287
DE-AC02-76ER-03130 ..... N92-14825
DE-AC02-80ET-15601 ..... N92-14862
DE-AC02-83CH-10093 ..... N92-14318
N92-14481
N92-14482
N92-14484
DE-AC03-76SF-00098 ..... N92-14135
N92-14136
N92-14147
N92-14148
N92-14149
N92-14150
N92-14151
N92-14152
N92-14155
N92-14157
N92-14164
N92-14175
N92-14189
N92-14289
N92-14290
N92-14316
N92-14338
N92-14340
N92-14341
N92-14494
N92-14583
N92-14609
N92-14703
N92-14778
N92-14808
N92-14815
N92-14866
N92-14867
N92-14873
N92-14876
N92-14941
DE-AC03-76SF-00515 ..... N92-14836
N92-14878
DE-AC03-87SF-17127 ..... N92-14864
DE-AC04-76DP-00613 ..... N92-14187
DE-AC04-76DP-00789 ..... N92-14104
N92-14105
N92-14137
N92-14153
N92-14156
N92-14159
N92-14165
N92-14178
N92-14188
N92-14273
N92-14288
N92-14293
N92-14377
N92-14378
N92-14388
N92-14455
N92-14464
N92-14483
N92-14610
N92-14612
N92-14613
N92-14687
N92-14842
N92-14863
N92-14864
DE-AC04-88DP-43495 ..... N92-14396
DE-AC05-84OR-21400 ..... N92-14127
N92-14145
N92-14154
N92-14185
N92-14265
N92-14387
N92-14804
DE-AC06-76RL-01830 ..... N92-14107
N92-14174
N92-14395
N92-14492
N92-14614
DE-AC06-87RL-10930 ..... N92-14614
N92-14803
DE-AC07-76ID-01570 ..... N92-14169
N92-14176
N92-14951
DE-FG02-84ER-60227 ..... N92-14487
DE-FG02-85ER-25001 ..... N92-14603
N92-14652
DE-FG02-86ER-13564 ..... N92-14113
DE-FG02-86ER-13582 ..... N92-14129
DE-FG02-86ER-45229 ..... N92-14162
DE-FG02-86ER-45278 ..... N92-14875
DE-FG02-87ER-13648 ..... N92-14297
DE-FG02-88ER-40465 ..... N92-14850
DE-FG02-89ER-14039 ..... N92-14130
DE-FG02-90ER-45426 ..... N92-14163
DE-FG02-90ER-61057 ..... N92-14493
DE-FG02-91ER-12106 ..... N92-14343
DE-FG03-87ER-13801 ..... N92-14317
DE-FG05-80ET-53088 ..... N92-14845
DE-FG05-85ER-13435 ..... N92-14126
DE-FG05-88ER-13833 ..... N92-14128
DE-FG05-88ER-13865 ..... N92-14804
DE-FG06-90ER-40537 ..... N92-14814
DE-FG07-90ER-13032 ..... N92-13937
DE-FG22-89PC-89784 ..... N92-14138
DTFA01-87-C-00014 ..... N92-14033
N92-14064
DTFA03-88-C-00041 ..... N92-14008
DTFA03-89-C-00023 ..... N92-14034
EEC-3075 ..... N92-14667
N92-14745
N92-14746
N92-14762
FQ7624-90-00010 ..... N92-14899
F04611-86-C-0103 ..... N92-14368
N92-14369
F04701-88-C-0089 ..... N92-14275
N92-14375
F19628-90-C-0002 ..... N92-14335
N92-14336
F33615-84-C-3202 ..... N92-14779
F33615-87-C-0012 ..... N92-14590
F33615-89-C-5733 ..... N92-14608
F33615-90-C-0005 ..... N92-14067
N92-14588
N92-14589
F33615-90-C-2066 ..... N92-14059
F49620-88-C-0064 ..... N92-14172
IBM-SUR-0449 ..... N92-14913
MDA903-87-C-0523 ..... N92-14597
MD277 ..... N92-14576
MIPR-90-0025 ..... N92-14334
NAGW-764 ..... N92-14944
NAGW-1683 ..... N92-13944
NAGW-1694 ..... N92-14937
NAGW-1936 ..... N92-14846
NAGW-2704 ..... N92-14560
NAG1-569 ..... N92-14117
NAG1-639 ..... N92-14121
NAG1-710 ..... N92-14038
NAG1-757 ..... N92-14333
NAG1-830 ..... N92-14390
NAG1-850 ..... N92-14041
NAG1-922 ..... N92-14066
NAG1-951 ..... N92-13996
NAG1-1004 ..... N92-14041
NAG1-1061 ..... N92-14607
NAG1-1119 ..... N92-14789
NAG1-1198 ..... N92-13999
NAG1-1211 ..... N92-14801
NAG1-1235 ..... N92-14572
NAG1-1278 ..... N92-13995
NAG2-542 ..... N92-14262
N92-14263
NAG2-593 ..... N92-14656
NAG2-637 ..... N92-14119
NAG3-181 ..... N92-14357
N92-14358
NAG3-792 ..... N92-14186
NAG3-799 ..... N92-14213
NAG3-934 ..... N92-14383
N92-14392
N92-14393
N92-14436
NAG3-960 ..... N92-14669
NAG3-1166 ..... N92-14220
NAG3-1183 ..... N92-14235
NAG3-1264 ..... N92-14122
NAG3-1286 ..... N92-13944
NAG5-532 ..... N92-14555
NAG5-557 ..... N92-14211
NAG5-931 ..... N92-14233
NAG5-1201 ..... N92-14939
NAG5-1346 ..... N92-14902
NAG5-1362 ..... N92-14945
NAG5-1484 ..... N92-14955
NAG8-689 ..... N92-14939
NAG9-310 ..... N92-14892
NASA ORDER C-99066-G N92-14322
NASA ORDER L-74809-C N92-13997
NASW-4528 ..... N92-14203
N92-14208
NASW-4535 ..... N92-14943
NASW-4571 ..... N92-14957
NASW-4574 ..... N92-14949
NAS1-18310 ..... N92-14261
NAS1-18849 ..... N92-14788
NAS1-19038 ..... N92-14598
NAS1-19399 ..... N92-14432
NAS2-12952 ..... N92-14668
NAS2-13072 ..... N92-14039
NAS2-13223 ..... N92-14209
NAS3-23722 ..... N92-14037
NAS3-24382 ..... N92-14435
NAS3-25087 ..... N92-14230

NAS3-25091 ..... N92-14205
NAS3-25266 ..... N92-14000
N92-14112
N92-14235
N92-14294
N92-14480
N92-14797
NAS3-25358 ..... N92-14320
NAS3-25416 ..... N92-14374
NAS3-25714 ..... N92-14110
NAS3-25715 ..... N92-14231
NAS3-25862 ..... N92-14224
NAS3-25866 ..... N92-14223
N92-14232
NAS5-26555 ..... N92-14089
NAS5-27772 ..... N92-14700
NAS5-30363 ..... N92-14490
NAS5-30680 ..... N92-14896
N92-14897
NAS5-30735 ..... N92-14330
NAS5-31000 ..... N92-14700
NAS5-31500 ..... N92-14071
N92-14072
N92-14073
N92-14074
N92-14075
N92-14078
N92-14082
N92-14083
NAS5-31619 ..... N92-14935
NAS7-918 ..... N92-14771
NAS8-30751 ..... N92-14939
NAS8-36431 ..... N92-14671
N92-14672
NAS8-36643 ..... N92-14106
NAS8-36719 ..... N92-14367
NAS8-36720 ..... N92-14391
NAS8-36955 ..... N92-14134
NAS8-37465 ..... N92-14344
NAS8-38781 ..... N92-14591
N92-14592
N92-14593
N92-14594
N92-14595
NAS9-17885 ..... N92-14085
NATO-CRG-90/1077 ..... N92-14665
NCC2-229 ..... N92-14586
NCC2-387 ..... N92-14668
N92-14894
NCC2-408 ..... N92-14668
N92-14694
NCC2-434 ..... N92-14098
NCC2-465 ..... N92-14314
NCC2-507 ..... N92-14313
NCC2-559 ..... N92-14603
N92-14652
NCC2-575 ..... N92-14036
NCC3-94 ..... N92-14120
NCC3-175 ..... N92-14295
NGT-50337 ..... N92-14956
NGT-50579 ..... N92-14911
NSERC-OGP-046506 ..... N92-14754
NSERC-OGP-0036747 ..... N92-14754
NSF ASC-88-02764 ..... N92-14698
NSF CBT-87-10561 ..... N92-13957
NSF CCR-89-57604 ..... N92-14723
NSF DMC-86-15336 ..... N92-13961
NSF ECS-89-10067 ..... N92-14914
NSF IRI-87-19392 ..... N92-14683
NSF MIP-90-01651 ..... N92-14384
NSF MIP-90-02664 ..... N92-14220
NSF 89-20891 ..... N92-14603
N92-14652
NSFC-C-59076261 ..... N92-13968
NWO-SIR-13-785 ..... N92-14723
N00014-83-K-0125 ..... N92-14254
N00014-85-C-0135 ..... N92-14278
N00014-85-K-0124 ..... N92-14035
N92-14587
N92-14683
N00014-85-K-0168 ..... N92-14254
N00014-86-K-0678 ..... N92-14684
N00014-87-C-0018 ..... N92-14300
N00014-87-G-0116 ..... N92-14574
N00014-87-K-0304 ..... N92-14698
N00014-87-K-0421 ..... N92-14312
N00014-88-K-0164 ..... N92-14683
N00014-88-K-0479 ..... N92-14284
N00014-89-J-1007 ..... N92-14257
N00014-89-J-1988 ..... N92-14254
N00014-89-J-2023 ..... N92-14283
N00014-89-J-3202 ..... N92-14384
N00014-90-J-1197 ..... N92-14256
N00014-90-J-4081 ..... N92-13935
N00014-90-WX-22034 ..... N92-14305
N00014-91-C-0102 ..... N92-14276
N00014-91-J-1045 ..... N92-14125
N00014-91-J-1046 ..... N92-14254
N00014-91-J-1409 ..... N92-14282
N00014-91-J-1531 ..... N92-14865
N00123-89-G-0531 ..... N92-14385
N00123-89-G-0575 ..... N92-14794
N00123-89-G-0582 ..... N92-14793
N00184-86-K-0684 ..... N92-14305
N92-14306
N92-14308
ONR PROJ. 201-124 ..... N92-14300
PROJ. 2308 ..... N92-14334
RP-1884-10 ..... N92-14362
SLS42C/719 ..... N92-14626
SLS42C/720 ..... N92-14627
STW-DWI-77-1397 ..... N92-14693
SWRI PROJ. 04-2453 ..... N92-14320
SWRI PROJ. 15-3399 ..... N92-14846
W-31-109-ENG-38 ..... N92-14161
N92-14291
N92-14461
N92-14489
N92-14491
N92-14800
W-7405-ENG-36 ..... N92-14332
N92-14339
N92-14686
N92-14821
N92-14826
N92-14841
N92-14901
W-7405-ENG-48 ..... N92-14264
N92-14340
N92-14488
N92-14557
N92-14900
W-7405-ENG-82 ..... N92-14381
N92-14879
030-09-01-01 ..... N92-14956
055-40-01-00-96 ..... N92-14248
108-30-30-40-01 ..... N92-14250
N92-14252
108-30-30-40-04 ..... N92-14251
147-13-17-20 ..... N92-14507
147-14-20-10 ..... N92-14516
147-14-30-10 ..... N92-14516
147-14-34-79 ..... N92-14519
147-14-51-10 ..... N92-14521
147-23-02 ..... N92-14528
310-10-62-34-00 ..... N92-14238
310-30-69-88-04 ..... N92-14244
310-30-69-91-22 ..... N92-14245
310-30-70-18-00 ..... N92-14241
310-30-70-56-01 ..... N92-14239
310-30-71-83-02 ..... N92-14240
N92-14242
310-30-71-87-02 ..... N92-14243
314-30-64-70-03 ..... N92-14246
314-40-41-91-69 ..... N92-14247
316-30-19 ..... N92-14953
316-30-19-41-06 ..... N92-14249
323-51-66-01 ..... N92-14790
324-02-00 ..... N92-14788
474-46-10 ..... N92-14114
505-59-30-01 ..... N92-13996
505-59-54-01 ..... N92-13997
505-62-0K N92-14179
505-62-21 ..... N92-14000
N92-14061
N92-14322
505-62-50 ..... N92-14037
505-62-52 ..... N92-13998
N92-14003
505-63-5B N92-14118
N92-14122
N92-14383
N92-14393
N92-14436
505-63-50-04 ..... N92-14432
505-68-10 ..... N92-14001
505-69-10 ..... N92-14063
506-41-11 ..... N92-14111
506-41-41 ..... N92-14170
N92-14294
N92-14485
506-42-31 ..... N92-14109
506-42-72 ..... N92-14112
506-43-41 ..... N92-14041
506-44-21-03 ..... N92-14261
510-01-50 ..... N92-14433
N92-14434
535-03-10 ..... N92-14002
535-03-11-03 ..... N92-14779
537-02-23 ..... N92-14795
N92-14797
553-13-00 ..... N92-14346
555-13-00 ..... N92-14435
582-01-11 ..... N92-14110
590-13-11 ..... N92-14120
590-14-21-01 ..... N92-14394
591-14-11 ..... N92-14480
593-21-00 ..... N92-14323
594-81-21 ..... N92-14649
650-60-21 ..... N92-14202
673-41-43-20 ..... N92-14539
673-61-07-30 ..... N92-14543
673-64-01-20 ..... N92-14538
992-16-04-05 ..... N92-14598

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-92013 ..... N92-14039* #

ACD-340 ..... N92-14034 #

ACTA-POLITEC-SCAND-ME-98 ..... N92-14142 #

AD-A237667 ..... N92-14059 #
AD-A240797 ..... N92-14791 #
AD-A240857 ..... N92-14180 #
AD-A240966 ..... N92-14253 #
AD-A240982 ..... N92-14124 #
AD-A240984 ..... N92-14274 #
AD-A240985 ..... N92-13990 #
AD-A240986 ..... N92-13991 #
AD-A240987 ..... N92-13992 #
AD-A241030 ..... N92-14792 #
AD-A241039 ..... N92-14608 #
AD-A241077 ..... N92-14375 #
AD-A241078 ..... N92-14275 #
AD-A241115 ..... N92-14566 #
AD-A241119 ..... N92-13993 #
AD-A241122 ..... N92-14574 #
AD-A241123 ..... N92-14181 #
AD-A241126 ..... N92-14276 #
AD-A241134 ..... N92-14597 #
AD-A241143 ..... N92-14764 #
AD-A241159 ..... N92-14683 #
AD-A241160 ..... N92-14384 #
AD-A241176 ..... N92-14277 #
AD-A241185 ..... N92-14865 #
AD-A241187 ..... N92-14331 #
AD-A241200 ..... N92-14684 #
AD-A241243 ..... N92-14278 #
AD-A241247 ..... N92-14385 #
AD-A241249 ..... N92-14035 #
AD-A241251 ..... N92-14587 #
AD-A241291 ..... N92-14254 #
AD-A241313 ..... N92-14386 #
AD-A241316 ..... N92-14793 #
AD-A241317 ..... N92-14794 #
AD-A241331 ..... N92-14255 #
AD-A241435 ..... N92-14440 #
AD-A241463 ..... N92-14334 #
AD-A241489 ..... N92-14005 #
AD-A241493 ..... N92-14588 #
AD-A241509 ..... N92-14685 #
AD-A241535 ..... N92-14837 #
AD-A241564 ..... N92-14315 #
AD-A241590 ..... N92-14589 #
AD-A241591 ..... N92-14590 #
AD-A241640 ..... N92-14133 #
AD-A241647 ..... N92-14802 #
AD-A241660 ..... N92-14171 #
AD-A241675 ..... N92-14067 #
AD-A241690 ..... N92-14069 #
AD-A241691 ..... N92-14657 #
AD-A241692 ..... N92-14658 #
AD-A241693 ..... N92-14659 #
AD-A241694 ..... N92-14660 #
AD-A241695 ..... N92-14661 #
AD-A241696 ..... N92-14662 #
AD-A241697 ..... N92-14663 #
AD-A241698 ..... N92-14664 #
AD-A241728 ..... N92-14335 #
AD-A241765 ..... N92-14336 #
AD-A241797 ..... N92-14282 #
AD-A241832 ..... N92-14256 #
AD-A241842 ..... N92-14899 #
AD-A241843 ..... N92-14125 #
AD-A241845 ..... N92-14283 #
AD-A241848 ..... N92-14257 #
AD-A241849 ..... N92-14172 #
AD-A241850 ..... N92-14284 #

AD-D014995 ..... N92-14279
AD-D014997 ..... N92-14280
AD-D014998 ..... N92-14281
AD-D015020 ..... N92-14376 #
AD-D015021 ..... N92-14258 #
AD-D015022 ..... N92-14838 #
AD-D015023 ..... N92-14182
AD-D015024 ..... N92-14040
AD-D015026 ..... N92-14183
AD-D015032 ..... N92-14184 #
AD-D015033 ..... N92-14839 #
AD-D015034 ..... N92-14062 #
AD-D015050 ..... N92-14144 #

AD-E200766 ..... N92-14253 #

AECS/IB-6 ..... N92-14596 #

AEDC-TR-91-12 ..... N92-14331 #

AFOSR-91-0764TR ..... N92-14315 #
AFOSR-91-0765TR ..... N92-14133 #
AFOSR-91-0790TR ..... N92-14334 #
AFOSR-91-0818TR ..... N92-14802 #
AFOSR-91-0887TR ..... N92-14172 #

AGARD-AR-284 ..... N92-14065 #

AGARD-LS-176 ..... N92-14046 #
AGARD-LS-179 ..... N92-14673 #

AI-M-1271 ..... N92-14683 #
AI-M-1286 ..... N92-14384 #
AI-M-1297 ..... N92-14035 #
AI-M-1312 ..... N92-14587 #

AIAA-91-2226 ..... N92-14109* #
AIAA-91-3424 ..... N92-14953* #
AIAA-92-0037 ..... N92-14001* #
AIAA-92-0065 ..... N92-14003* #
AIAA-92-0152 ..... N92-13998* #
AIAA-92-0274 ..... N92-14002* #
AIAA-92-0363 ..... N92-14323* #
AIAA-92-0500 ..... N92-14795* #
AIAA-92-0501 ..... N92-14797* #
AIAA-92-0503 ..... N92-14000* #
AIAA-92-0794 ..... N92-14114* #
AIAA-92-1293 ..... N92-14649* #

AIP-138 ..... N92-14684 #

AL-TP-1991-0044 ..... N92-14899 #
AL-TP-1991-0047 ..... N92-14067 #

AL-TR-1991-0010 ..... N92-14590 #
AL-TR-1991-0031 ..... N92-14589 #

ALS/TR-91-005 ..... N92-14273 #

ANL-HEP-TR-91-74 ..... N92-14800 #

ANL/CP-73535 ..... N92-14291 #
ANL/CP-73968 ..... N92-14489 #
ANL/CP-74212 ..... N92-14161 #
ANL/CP-74364 ..... N92-14491 #

ARI-TR-930 ..... N92-14597 #

ASE-5752 ..... N92-14935* #

ASI-690-339-90 ..... N92-14597 #

AWE-0-16/90 ..... N92-14140 #

BCRS-90-36 ..... N92-14441 #
BCRS-90-39 ..... N92-14442 #
BCRS-90-41 ..... N92-14443 #
BCRS-91-03 ..... N92-14444 #

BNL-45962 ..... N92-14799 #

BRL-TR-3260 ..... N92-14180 #

BR302905 ..... N92-14140 #
BR303121 ..... N92-14624 #
BR303122 ..... N92-14007 #
BR303318 ..... N92-14166 #
BR303454 ..... N92-14629 #
BR303455 ..... N92-14628 #
BR303456 ..... N92-14267 #
BR303626 ..... N92-14626 #
BR303627 ..... N92-14319 #
BR303852 ..... N92-14139 #
BR303864 ..... N92-14917 #
BR304043 ..... N92-14627 #
BR304206-PT-1 ..... N92-14099 #
BR304210 ..... N92-14625 #
BR304234 ..... N92-14630 #

CAL-1946 ..... N92-14945* #

CBIP-M-62 ..... N92-14683 #

CEAT-M5-5443/01 ..... N92-14042 #

CEAT-S8-6551-PARTIEL-1-PT-1 ..... N92-14043 #

CERL-SR-N-91/24 ..... N92-14792 #

CNIC-00382 ..... N92-14854 #

CONF-890398-2 ..... N92-14557 #
CONF-900466-102 ..... N92-14149 #
CONF-900764-3 ..... N92-14164 #
CONF-900764-4 ..... N92-14151 #
CONF-901105-129 ..... N92-14872 #
CONF-901105-129 ..... N92-14876 #
CONF-901105-130 ..... N92-14873 #
CONF-901165-2 ..... N92-14826 #
CONF-910422-4 ..... N92-14803 #
CONF-910427-4 ..... N92-14494 #
CONF-910505-407 ..... N92-14341 #
CONF-910505-412 ..... N92-14815 #
CONF-910580-5 ..... N92-14867 #
CONF-910635-17 ..... N92-14150 #
CONF-910659-33 ..... N92-14488 #
CONF-910662-3 ..... N92-14778 #
CONF-910707-7 ..... N92-14153 #
CONF-910707-8 ..... N92-14155 #
CONF-910801-24 ..... N92-14862 #
CONF-910808-5 ..... N92-14154 #
CONF-910860-1 ..... N92-14291 #
CONF-910869-18 ..... N92-14265 #
CONF-910904-1 ..... N92-14159 #
CONF-910943-2 ..... N92-14799 #
CONF-910996-1 ..... N92-14137 #
CONF-911003-17 ..... N92-14156 #
CONF-911055-3 ..... N92-14178 #
CONF-911202-1 ..... N92-14866 #
CONF-911213-6 ..... N92-14387 #
CONF-911240-2 ..... N92-14145 #
CONF-911241-3 ..... N92-14388 #
CONF-911243-1 ..... N92-14900 #
CONF-911257-1 ..... N92-14610 #
CONF-8903109-6 ..... N92-14152 #
CONF-9004190-13 ..... N92-14825 #
CONF-9006176-9 ..... N92-14864 #
CONF-9007145-4 ..... N92-14176 #
CONF-9007226-1 ..... N92-14136 #
CONF-9008114 ..... N92-14871 #
CONF-9010363 ..... N92-14796 #
CONF-9102114-ABST ..... N92-14878 #
CONF-9103177-1 ..... N92-14169 #

CONF-9104107-1 ..... N92-14583 #
CONF-9105113-3 ..... N92-14703 #
CONF-9106213 ..... N92-14482 #
CONF-9106275-3 ..... N92-14147 #
CONF-9106283-1 ..... N92-14941 #
CONF-9106284-1 ..... N92-14135 #
CONF-9107104-16 ..... N92-14492 #
CONF-9107115-51 ..... N92-14339 #
CONF-9107138-2 ..... N92-14612 #
CONF-9107179-1 ..... N92-14148 #
CONF-9107182-1 ..... N92-14105* #
CONF-9107182-2 ..... N92-14104* #
CONF-9108118-10 ..... N92-14340 #
CONF-9108118-11 ..... N92-14338 #
CONF-9108170-1 ..... N92-14842 #
CONF-9108172-2 ..... N92-14189 #
CONF-9109103-2 ..... N92-14161 #
CONF-9109110-8 ..... N92-14686 #
CONF-9109226-16 ..... N92-14174 #
CONF-9109226-19 ..... N92-14107 #
CONF-9109258-1 ..... N92-14489 #
CONF-9109259-9 ..... N92-14188 #
CONF-9109270-1 ..... N92-14395 #
CONF-9109277-1 ..... N92-14841 #
CONF-9109291-1 ..... N92-14814 #
CONF-9110217-1 ..... N92-14951 #
CONF-9110220-1 ..... N92-14491 #
CONF-9110224-1 ..... N92-14901 #
CONF-9110228-2 ..... N92-14377 #
CONF-9110234-1 ..... N92-14863 #
CONF-9110240-1 ..... N92-14165 #
CONF-9111101-1 ..... N92-14613 #
CONF-9111106-1 ..... N92-14378 #
CONF-9111108-1 ..... N92-14293 #

COO-3130TC-52 ..... N92-14825 #

CP-474 ..... N92-14065 #

CRREL-91-15 ..... N92-14440 #

CTN-91-60222 ..... N92-13975 #
CTN-91-60231 ..... N92-14009
CTN-91-60271 ..... N92-14345 #
CTN-91-60273 ..... N92-14060 #

CU-CSSC-91-28 ..... N92-14436* #

CWI-AM-R9101 ..... N92-14741 #
CWI-AM-R9102 ..... N92-14759 #
CWI-AM-R9103 ..... N92-14742 #
CWI-AM-R9104 ..... N92-14760 #

CWI-BS-R9101 ..... N92-14698 #
CWI-BS-R9104 ..... N92-14743 #
CWI-BS-R9106 ..... N92-14744 #
CWI-BS-R9107 ..... N92-14761 #
CWI-BS-R9108 ..... N92-14748 #
CWI-BS-R9109 ..... N92-14763 #
CWI-BS-R9114 ..... N92-14770 #

CWI-CS-R9110 ..... N92-14655 #

DE90-012531 ..... N92-14297 #
DE90-013325 ..... N92-14825 #
DE90-013400 ..... N92-14864 #
DE90-798727 ..... N92-14843 #
DE91-002175 ..... N92-14481
DE91-011756 ..... N92-14878 #
DE91-013217 ..... N92-14169 #
DE91-015001 ..... N92-14484 #
DE91-015008 ..... N92-14482 #
DE91-015030 ..... N92-14318 #
DE91-016606 ..... N92-14900 #
DE91-017690 ..... N92-14387 #
DE91-017847 ..... N92-14612 #
DE91-018165 ..... N92-14803 #
DE91-018253 ..... N92-14145 #
DE91-018358 ..... N92-14388 #
DE91-018411 ..... N92-14273 #
DE91-018424 ..... N92-14845 #
DE91-018467 ..... N92-14488 #
DE91-018526 ..... N92-14126 #
DE91-018528 ..... N92-14128 #
DE91-018532 ..... N92-14804 #
DE91-018545 ..... N92-14489 #
DE91-018548 ..... N92-14291 #
DE91-018554 ..... N92-14879 #
DE91-018610 ..... N92-14127 #
DE91-018677 ..... N92-14159 #
DE91-018678 ..... N92-14153 #
DE91-018708 ..... N92-14176 #
DE91-018723 ..... N92-14557 #
DE91-018803 ..... N92-14129 #
DE91-018804 ..... N92-14113 #
DE91-018827 ..... N92-14395 #
DE91-018832 ..... N92-14951 #
DE91-018849 ..... N92-14154 #
DE91-018967 ..... N92-14130 #
DE91-623480 ..... N92-14709 #
DE91-623483 ..... N92-14890 #
DE91-623494 ..... N92-14946 #
DE91-623503 ..... N92-14710 #
DE91-623519 ..... N92-14706 #
DE91-623551 ..... N92-14342 #
DE91-623605 ..... N92-14160 #
DE91-623616 ..... N92-14131 #
DE91-623659 ..... N92-14874 #
DE91-623660 ..... N92-14816 #
DE91-623737 ..... N92-14859 #
DE91-623793 ..... N92-14952 #
DE91-623947 ..... N92-14817 #
DE91-624093 ..... N92-14809 #
DE91-624220 ..... N92-14132 #
DE91-624373 ..... N92-14158 #
DE91-625051 ..... N92-14961 #
DE91-625052 ..... N92-14962 #
DE91-626549 ..... N92-14851 #
DE91-626554 ..... N92-14852 #
DE91-626576 ..... N92-14853 #
DE91-628004 ..... N92-14887 #
DE91-628005 ..... N92-14707 #
DE91-628029 ..... N92-14708 #
DE91-628030 ..... N92-14888 #
DE91-628031 ..... N92-14818 #
DE91-628032 ..... N92-14834 #
DE91-628033 ..... N92-14749 #
DE91-628070 ..... N92-14558 #
DE91-628071 ..... N92-14559 #
DE91-628072 ..... N92-14260 #
DE91-628073 ..... N92-14889 #
DE91-628109 ..... N92-14881 #
DE91-628387 ..... N92-14177 #
DE91-628424 ..... N92-14854 #
DE91-628619 ..... N92-14942 #
DE91-632213 ..... N92-14596 #
DE91-634058 ..... N92-14880 #
DE91-634069 ..... N92-14704 #
DE91-634207 ..... N92-14868 #
DE91-634422 ..... N92-14940 #
DE91-634556 ..... N92-14701 #
DE91-635154 ..... N92-14567 #
DE91-635156 ..... N92-14568 #
DE91-635165 ..... N92-14486 #
DE91-635166 ..... N92-14569 #
DE91-635167 ..... N92-14259 #
DE91-635168 ..... N92-14556 #
DE91-635323 ..... N92-14585 #
DE91-635597 ..... N92-14337 #
DE91-635892 ..... N92-14840 #
DE91-635976 ..... N92-14765 #
DE91-635977 ..... N92-14705 #
DE91-635986 ..... N92-14882 #
DE91-635987 ..... N92-14883 #
DE91-635999 ..... N92-14702 #
DE91-636027 ..... N92-14884 #
DE91-636029 ..... N92-14885 #
DE91-636031 ..... N92-14810 #
DE91-636032 ..... N92-14811 #
DE91-636082 ..... N92-14886 #
DE91-636263 ..... N92-14812 #
DE91-636293 ..... N92-14828 #
DE91-636317 ..... N92-14869 #
DE91-636318 ..... N92-14870 #
DE91-636499 ..... N92-14855 #
DE91-636500 ..... N92-14856 #
DE91-636586 ..... N92-14857 #
DE91-636636 ..... N92-14858 #
DE91-636815 ..... N92-14847 #
DE91-636816 ..... N92-14848 #
DE91-636999 ..... N92-14173 #
DE91-637000 ..... N92-14285 #
DE91-637100 ..... N92-14805 #
DE91-637129 ..... N92-14806 #
DE91-637356 ..... N92-14807 #
DE91-638175 ..... N92-14389 #
DE91-638281 ..... N92-14146 #
DE91-638485 ..... N92-14960 #
DE91-638486 ..... N92-14849 #
DE91-638960 ..... N92-14829 #
DE91-638997 ..... N92-14827 #
DE91-639001 ..... N92-14830 #
DE91-639002 ..... N92-14831 #
DE91-639003 ..... N92-14832 #
DE91-639062 ..... N92-14833 #
DE91-639071 ..... N92-14871 #
DE91-639556 ..... N92-14286 #
DE91-640663 ..... N92-14819 #
DE91-640899 ..... N92-14860 #
DE91-640901 ..... N92-14861 #
DE91-641534 ..... N92-14891 #
DE91-641606 ..... N92-14292 #
DE91-641846 ..... N92-14947 #
DE91-641867 ..... N92-14835 #
DE91-642281 ..... N92-14820 #
DE91-642293 ..... N92-14796 #
DE91-767869 ..... N92-14813 #
DE92-000033 ..... N92-14487 #
DE92-000052 ..... N92-14875 #
DE92-000134 ..... N92-14799 #
DE92-000142 ..... N92-14174 #
DE92-000145 ..... N92-14107 #
DE92-000152 ..... N92-14381 #
DE92-000153 ..... N92-14332 #
DE92-000185 ..... N92-14901 #
DE92-000208 ..... N92-14826 #
DE92-000218 ..... N92-14686 #
DE92-000242 ..... N92-14377 #
DE92-000251 ..... N92-14841 #
DE92-000268 ..... N92-14491 #
DE92-000294 ..... N92-14800 #
DE92-000297 ..... N92-14339 #
DE92-000366 ..... N92-14161 #
DE92-000402 ..... N92-14185 #
DE92-000473 ..... N92-14492 #
DE92-000599 ..... N92-14287 #
DE92-000604 ..... N92-14483 #
DE92-000609 ..... N92-14288 #
DE92-000611 ..... N92-14687 #
DE92-000634 ..... N92-14862 #
DE92-000659 ..... N92-14821 #
DE92-000661 ..... N92-14187 #
DE92-000691 ..... N92-14609 #
DE92-000711 ..... N92-14289 #
DE92-000734 ..... N92-14155 #
DE92-000755 ..... N92-14316 #
DE92-000758 ..... N92-14317 #
DE92-000760 ..... N92-14162 #
DE92-000764 ..... N92-14163 #
DE92-000765 ..... N92-14493 #
DE92-000789 ..... N92-14156 #
DE92-000795 ..... N92-14842 #
DE92-000806 ..... N92-14941 #
DE92-000811 ..... N92-14703 #
DE92-000815 ..... N92-14175 #
DE92-000817 ..... N92-14610 #
DE92-000818 ..... N92-14188 #
DE92-000822 ..... N92-14863 #
DE92-000824 ..... N92-14850 #
DE92-000825 ..... N92-14814 #
DE92-000837 ..... N92-14808 #
DE92-000839 ..... N92-14340 #
DE92-000842 ..... N92-14147 #
DE92-000843 ..... N92-14135 #
DE92-000849 ..... N92-14866 #
DE92-000850 ..... N92-14778 #
DE92-000851 ..... N92-14148 #
DE92-000852 ..... N92-14583 #
DE92-000855 ..... N92-14157 #
DE92-000859 ..... N92-14341 #
DE92-000868 ..... N92-14872 #
DE92-000893 ..... N92-14876 #
DE92-000898 ..... N92-14873 #
DE92-000899 ..... N92-14164 #
DE92-000900 ..... N92-14149 #
DE92-000903 ..... N92-14150 #
DE92-000905 ..... N92-14189 #
DE92-000906 ..... N92-14494 #
DE92-000907 ..... N92-14290 #
DE92-000921 ..... N92-14338 #
DE92-000926 ..... N92-14151 #
DE92-000927 ..... N92-14152 #
DE92-000928 ..... N92-14136 #
DE92-000940 ..... N92-14815 #
DE92-000950 ..... N92-14137 #
DE92-000951 ..... N92-14104* #
DE92-000953 ..... N92-14165 #
DE92-000954 ..... N92-14867 #
DE92-000972 ..... N92-14343 #
DE92-000981 ..... N92-14178 #
DE92-000982 ..... N92-14613 #
DE92-000988 ..... N92-14105* #
DE92-000998 ..... N92-14378 #
DE92-001605 ..... N92-14396 #
DE92-001657 ..... N92-14138 #
DE92-001715 ..... N92-14293 #
DE92-001794 ..... N92-14264 #
DE92-002017 ..... N92-14836 #
DE92-002061 ..... N92-14265 #
DE92-002106 ..... N92-14614 #

DIGEL-1991-4 ..... N92-14296 #

DLR-FB-90-03 ..... N92-14438 #
DLR-FB-91-05 ..... N92-14269 #
DLR-FB-91-06 ..... N92-14959 #
DLR-FB-91-07 ..... N92-14571 #

DOE/CH-10093/98 ..... N92-14481
DOE/CH-10093/114 ..... N92-14318 #
DOE/CH-10093/117 ..... N92-14484 #

DOE/ER-03130/52 ..... N92-14825 #
DOE/ER-12108/1 ..... N92-14343 #
DOE/ER-13435/6 ..... N92-14126 #
DOE/ER-13564/10 ..... N92-14113 #
DOE/ER-13582/5 ..... N92-14129 #
DOE/ER-13648/12 ..... N92-14297 #
DOE/ER-13801/T1 ..... N92-14317 #
DOE/ER-13833/11 ..... N92-14128 #
DOE/ER-13865/042 ..... N92-14804 #
DOE/ER-14039/2 ..... N92-14130 #
DOE/ER-40465/T2 ..... N92-14850 #
DOE/ER-40537/9 ..... N92-14814 #
DOE/ER-45229/24 ..... N92-14162 #
DOE/ER-45278/5 ..... N92-14875 #
DOE/ER-45426/1 ..... N92-14163 #
DOE/ER-60227/6 ..... N92-14487 #
DOE/ER-61057/1 ..... N92-14493 #

DOE/ET-53088/517 ..... N92-14845 #

DOE/PC-89784/8 ..... N92-14138 #

DOT/FAA/CT-TN91/50 ..... N92-14270 #

DOT/FAA/CT-91/6 ..... N92-14034 #
DOT/FAA/CT-91/14 ..... N92-14008 #
DOT/FAA/CT-91/16 ..... N92-14064 #

DOT/FAA/RD-90/5 ..... N92-14033 #

DREP-TM-88-20 ..... N92-14345 #

E-2913 ..... N92-14061* #
E-5628 ..... N92-14346* #
E-6418 ..... N92-14109* #
E-6491 ..... N92-14122* #
E-6529 ..... N92-14649* #
E-6543 ..... N92-14294* #
E-6548 ..... N92-14202* #
E-6557 ..... N92-14120* #
E-6559 ..... N92-14179* #
E-6595 ..... N92-14170* #
E-6661 ..... N92-14953* #
E-6666 ..... N92-14118* #
E-6679 ..... N92-13998* #
E-6680 ..... N92-14480* #
E-6681 ..... N92-14112* #
E-6683 ..... N92-14111* #
E-6700 ..... N92-14485* #
E-6704 ..... N92-14433* #
E-6705 ..... N92-14795* #
E-6717 ..... N92-14063* #
E-6723 ..... N92-14434* #
E-6726 ..... N92-14322* #
E-6739 ..... N92-14003* #
E-6741 ..... N92-14114* #
E-6743 ..... N92-14797* #
E-6744 ..... N92-14000* #
E-6759 ..... N92-14323* #
E-6778 ..... N92-14001* #
E-6784 ..... N92-14002* #

EGG-M-90299 ..... N92-14176 #
EGG-M-90406 ..... N92-14169 #
EGG-M-91352 ..... N92-14951 #

ESA-PSS-01-21-ISSUE-2 ..... N92-14631 #
ESA-PSS-04-104-VOL-1-ISSUE-2 ..... N92-14268 #

ESA-TT-1180 ..... N92-14168 #
ESA-TT-1217 ..... N92-14438 #

ESD-TR-91-067 ..... N92-14335 #
ESD-TR-91-093 ..... N92-14336 #

ESL-721566-2 ..... N92-14257 #

ETN-91-90116 ..... N92-14584 #
ETN-91-90195 ..... N92-14382 #
ETN-91-90247 ..... N92-14606
ETN-91-99889 ..... N92-14605 #
ETN-92-90304 ..... N92-14296 #
ETN-92-90311 ..... N92-14573
ETN-92-90317 ..... N92-14397 #
ETN-92-90319 ..... N92-14007 #
ETN-92-90320 ..... N92-14631 #
ETN-92-90323 ..... N92-14268 #
ETN-92-90325 ..... N92-14269 #
ETN-92-90326 ..... N92-14959 #
ETN-92-90327 ..... N92-14571 #
ETN-92-90328 ..... N92-14632 #
ETN-92-90334 ..... N92-14724 #
ETN-92-90341 ..... N92-14725 #
ETN-92-90342 ..... N92-14726 #
ETN-92-90343 ..... N92-14727 #
ETN-92-90344 ..... N92-14728 #
ETN-92-90345 ..... N92-14729 #
ETN-92-90347 ..... N92-14730 #
ETN-92-90348 ..... N92-14731 #
ETN-92-90350 ..... N92-14691 #
ETN-92-90351 ..... N92-14692 #
ETN-92-90352 ..... N92-14633 #
ETN-92-90356 ..... N92-14755 #
ETN-92-90357 ..... N92-14634 #
ETN-92-90358 ..... N92-14918 #
ETN-92-90359 ..... N92-14756 #
ETN-92-90360 ..... N92-14635 #
ETN-92-90361 ..... N92-14636 #
ETN-92-90362 ..... N92-14637 #
ETN-92-90363 ..... N92-14638 #
ETN-92-90364 ..... N92-14600 #
ETN-92-90365 ..... N92-14639 #
ETN-92-90368 ..... N92-14640 #
ETN-92-90369 ..... N92-14601 #
ETN-92-90372 ..... N92-14732 #
ETN-92-90373 ..... N92-14641 #
ETN-92-90374 ..... N92-14642 #
ETN-92-90375 ..... N92-14893 #
ETN-92-90376 ..... N92-14643 #
ETN-92-90377 ..... N92-14644 #
ETN-92-90378 ..... N92-14645 #
ETN-92-90379 ..... N92-14646 #
ETN-92-90380 ..... N92-14647 #
ETN-92-90381 ..... N92-14757 #
ETN-92-90392 ..... N92-14321 #
ETN-92-90393 ..... N92-14733 #
ETN-92-90394 ..... N92-14693 #
ETN-92-90395 ..... N92-14648 #
ETN-92-90396 ..... N92-14734 #
ETN-92-90397 ..... N92-14650 #
ETN-92-90399 ..... N92-14437 #
ETN-92-90400 ..... N92-14758 #
ETN-92-90409 ..... N92-14324 #
ETN-92-90410 ..... N92-14766 #
ETN-92-90411 ..... N92-14735 #
ETN-92-90412 ..... N92-14736 #
ETN-92-90413 ..... N92-14737 #
ETN-92-90414 ..... N92-14325 #
ETN-92-90415 ..... N92-14326 #
ETN-92-90416 ..... N92-14004 #
ETN-92-90417 ..... N92-14798 #
ETN-92-90418 ..... N92-14044 #
ETN-92-90419 ..... N92-14123 #
ETN-92-90420 ..... N92-14045 #
ETN-92-90421 ..... N92-14576 #
ETN-92-90422 ..... N92-14097 #
ETN-92-90423 ..... N92-14115 #
ETN-92-90424 ..... N92-14767 #
ETN-92-90425 ..... N92-14768 #
ETN-92-90427 ..... N92-14738 #
ETN-92-90428 ..... N92-14739 #
ETN-92-90429 ..... N92-14740 #
ETN-92-90430 ..... N92-14599 #
ETN-92-90436 ..... N92-14441 #
ETN-92-90437 ..... N92-14442 #
ETN-92-90438 ..... N92-14443 #
ETN-92-90439 ..... N92-14444 #
ETN-92-90443 ..... N92-14822 #
ETN-92-90448 ..... N92-14823 #
ETN-92-90449 ..... N92-14824 #
ETN-92-90454 ..... N92-14141 #
ETN-92-90455 ..... N92-14142 #
ETN-92-90456 ..... N92-14327 #
ETN-92-90457 ..... N92-14328 #
ETN-92-90458 ..... N92-14329 #
ETN-92-90459 ..... N92-14877 #
ETN-92-90463 ..... N92-14741 #
ETN-92-90464 ..... N92-14759 #
ETN-92-90465 ..... N92-14742 #
ETN-92-90466 ..... N92-14760 #
ETN-92-90467 ..... N92-14698 #
ETN-92-90468 ..... N92-14743 #
ETN-92-90469 ..... N92-14744 #
ETN-92-90470 ..... N92-14761 #
ETN-92-90472 ..... N92-14667 #
ETN-92-90473 ..... N92-14769 #
ETN-92-90474 ..... N92-14651 #
ETN-92-90479 ..... N92-14652* #
ETN-92-90480 ..... N92-14603* #
ETN-92-90481 ..... N92-14271 #
ETN-92-90482 ..... N92-14653 #
ETN-92-90486 ..... N92-14745 #
ETN-92-90487 ..... N92-14762 #
ETN-92-90488 ..... N92-14654 #
ETN-92-90489 ..... N92-14746 #
ETN-92-90490 ..... N92-14919 #
ETN-92-90491 ..... N92-14747 #
ETN-92-90492 ..... N92-14711 #
ETN-92-90493 ..... N92-14686 #
ETN-92-90494 ..... N92-14615 #
ETN-92-90495 ..... N92-14712 #
ETN-92-90496 ..... N92-14713 #
ETN-92-90497 ..... N92-14714 #
ETN-92-90498 ..... N92-14715 #
ETN-92-90499 ..... N92-14716 #
ETN-92-90500 ..... N92-14717 #
ETN-92-90501 ..... N92-14689 #
ETN-92-90502 ..... N92-14690 #
ETN-92-90503 ..... N92-14750 #
ETN-92-90504 ..... N92-14751 #
ETN-92-90505 ..... N92-14379 #
ETN-92-90506 ..... N92-14718 #
ETN-92-90507 ..... N92-14752 #
ETN-92-90508 ..... N92-14719 #
ETN-92-90509 ..... N92-14616 #
ETN-92-90510 ..... N92-14617 #
ETN-92-90512 ..... N92-14618 #
ETN-92-90513 ..... N92-14619 #
ETN-92-90514 ..... N92-14753 #
ETN-92-90515 ..... N92-14665 #
ETN-92-90516 ..... N92-14266 #
ETN-92-90517 ..... N92-14666 #
ETN-92-90518 ..... N92-14620 #
ETN-92-90519 ..... N92-14720 #
ETN-92-90520 ..... N92-14621 #
ETN-92-90521 ..... N92-14721 #
ETN-92-90522 ..... N92-14722 #
ETN-92-90523 ..... N92-14622 #
ETN-92-90524 ..... N92-14754 #
ETN-92-90525 ..... N92-14623 #
ETN-92-90526 ..... N92-14723 #
ETN-92-90527 ..... N92-14699 #
ETN-92-90539 ..... N92-14748 #
ETN-92-90540 ..... N92-14763 #
ETN-92-90545 ..... N92-14770 #
ETN-92-90550 ..... N92-14655 #
ETN-92-90678 ..... N92-14190 #
ETN-92-90687 ..... N92-14570
ETN-92-90688 ..... N92-14575
ETN-92-90690 ..... N92-14624 #
ETN-92-90691 ..... N92-14139 #
ETN-92-90692 ..... N92-14625 #
ETN-92-90693 ..... N92-14626 #
ETN-92-90694 ..... N92-14627 #
ETN-92-90695 ..... N92-14628 #
ETN-92-90696 ..... N92-14629 #
ETN-92-90697 ..... N92-14267 #
ETN-92-90698 ..... N92-14917 #
ETN-92-90699 ..... N92-14630 #
ETN-92-90700 ..... N92-14319 #
ETN-92-90701 ..... N92-14166 #
ETN-92-90702 ..... N92-14099 #
ETN-92-90705 ..... N92-14140 #
ETN-92-90712 ..... N92-14167
ETN-92-90739 ..... N92-14168 #
ETN-92-90740 ..... N92-14438 #
ETN-92-99978 ..... N92-14042 #
ETN-92-99979 ..... N92-14043 #

FAA-AMS-420 ..... N92-13926 #
FAA-AMS-420 ..... N92-13927 #

FAA-APO-91-5 ..... N92-14005 #

FEI-1903 ..... N92-14160 #

FNAL-TM-1754 ..... N92-14287 #

FR-721711-4-VOL-1 ..... N92-14262* #
FR-721711-4-VOL-2 ..... N92-14263* #

FTD-ID(RS)T-0167-91 ..... N92-13991 #
FTD-ID(RS)T-0170-91 ..... N92-13992 #
FTD-ID(RS)T-0291-91 ..... N92-13990 #
FTD-ID(RS)T-0461-91 ..... N92-13993 #

GITAER-91-6 ..... N92-13995* #

GPO-38-725 ..... N92-14926 #
GPO-44-871 ..... N92-14924 #
GPO-46-368 ..... N92-14929 #
GPO-48-180 ..... N92-14928 #

HR-2519-PP ..... N92-14922 #
HR-2519-RS ..... N92-14920 #

IAE-4944-1 ..... N92-14874 #
IAE-4948-1 ..... N92-14710 #
IAE-5002-2 ..... N92-14807 #
IAE-5013-8 ..... N92-14847 #
IAE-5028-7 ..... N92-14848 #

IAEA-NDS-125(REV-0) ..... N92-14809 #

IC-90/358 ..... N92-14840 #
IC-90/393 ..... N92-14486 #
IC-90/402 ..... N92-14567 #
IC-90/406 ..... N92-14880 #
IC-90/409 ..... N92-14568 #
IC-90/432 ..... N92-14569 #
IC-90/438 ..... N92-14259 #
IC-90/439 ..... N92-14556 #
IC-90/447 ..... N92-14585 #
IC-90/449 ..... N92-14337 #

ICOMP-91-26 ..... N92-14322* #

IFSR-517 ..... N92-14845 #

IFVE-OLU-90-40 ..... N92-14827 #

IFVE-ONF-90-149 ..... N92-14805 #
IFVE-ONF-90-152 ..... N92-14286 #

IFVE-OTF-89-117 ..... N92-14558 #
IFVE-OTF-89-143 ..... N92-14946 #
IFVE-OTF-89-193 ..... N92-14709 #
IFVE-OTF-90-84 ..... N92-14885 #
IFVE-OTF-90-95 ..... N92-14886 #
IFVE-OTF-90-107 ..... N92-14765 #
IFVE-OTF-90-140 ..... N92-14884 #

IHEP-OTF-89-117 ..... N92-14558 #
IHEP-OTF-90-84 ..... N92-14885 #
IHEP-OTF-90-95 ..... N92-14886 #
IHEP-OTF-90-107 ..... N92-14765 #
IHEP-OTF-90-140 ..... N92-14884 #

INIS-BR-2431 ..... N92-14940 #
INIS-BR-2452 ..... N92-14868 #
INIS-BR-2648 ..... N92-14819 #

INIS-MF-12799 ..... N92-14852 #
INIS-MF-12800 ..... N92-14853 #
INIS-MF-12802 ..... N92-14851 #
INIS-MF-12886 ..... N92-14871 #
INIS-MF-12892 ..... N92-14820 #
INIS-MF-12894 ..... N92-14860 #
INIS-MF-12896 ..... N92-14861 #
INIS-MF-12940 ..... N92-14292 #
INIS-MF-12943 ..... N92-14796 #

INP-1492/PL ..... N92-14835 #
INP-1494/PH ..... N92-14891 #
INP-1501/PH ..... N92-14947 #

INS-813 ..... N92-14813 #

IPMASH-305 ..... N92-14829 #

IS-T-1504 ..... N92-14879 #
IS-T-1514 ..... N92-14381 #

ISAL-91-0014 ..... N92-14877 #

ISBN-0-16-035630-X ..... N92-14933 #
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ISSN-001-687X ..... N92-14142 #
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ISSN-0169-1708 ..... N92-14570
ISSN-0169-1708 ..... N92-14575
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ISSN-0169-2690 ..... N92-14616 #
ISSN-0169-2690 ..... N92-14617 #
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ISSN-0169-2690 ..... N92-14691 #
ISSN-0169-2690 ..... N92-14692 #
ISSN-0169-2690 ..... N92-14711 #
ISSN-0169-2690 ..... N92-14712 #
ISSN-0169-2690 ..... N92-14713 #
ISSN-0169-2690 ..... N92-14714 #
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ISSN-0169-2690 ..... N92-14716 #
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ISSN-0169-2690 ..... N92-14718 #
ISSN-0169-2690 ..... N92-14719 #
ISSN-0169-2690 ..... N92-14724 #
ISSN-0169-2690 ..... N92-14725 #
ISSN-0169-2690 ..... N92-14726 #
ISSN-0169-2690 ..... N92-14727 #
ISSN-0169-2690 ..... N92-14728 #
ISSN-0169-2690 ..... N92-14729 #
ISSN-0169-2690 ..... N92-14730 #
ISSN-0169-2690 ..... N92-14731 #
ISSN-0169-2690 ..... N92-14750 #
ISSN-0169-2690 ..... N92-14751 #
ISSN-0169-2690 ..... N92-14752 #
ISSN-0357-9387 ..... N92-14190 #
ISSN-0379-4059 ..... N92-14268 #
ISSN-0379-4059 ..... N92-14631 #
ISSN-0751-1337 ..... N92-14584 #
ISSN-0915-633X ..... N92-14844 #
ISSN-0920-2358 ..... N92-14893 #
ISSN-0922-5641 ..... N92-14321 #
ISSN-0922-5641 ..... N92-14324 #
ISSN-0922-5641 ..... N92-14437 #
ISSN-0922-5641 ..... N92-14601 #
ISSN-0922-5641 ..... N92-14641 #
ISSN-0922-5641 ..... N92-14642 #
ISSN-0922-5641 ..... N92-14643 #
ISSN-0922-5641 ..... N92-14644 #
ISSN-0922-5641 ..... N92-14645 #
ISSN-0922-5641 ..... N92-14646 #
ISSN-0922-5641 ..... N92-14647 #
ISSN-0922-5641 ..... N92-14648 #
ISSN-0922-5641 ..... N92-14650 #
ISSN-0922-5641 ..... N92-14693 #
ISSN-0922-5641 ..... N92-14732 #
ISSN-0922-5641 ..... N92-14733 #
ISSN-0922-5641 ..... N92-14734 #
ISSN-0922-5641 ..... N92-14735 #
ISSN-0922-5641 ..... N92-14736 #
ISSN-0922-5641 ..... N92-14737 #
ISSN-0922-5641 ..... N92-14757 #
ISSN-0922-5641 ..... N92-14758 #
ISSN-0922-5641 ..... N92-14766 #
ISSN-0922-5641 ..... N92-14767 #
ISSN-0923-1714 ..... N92-14266 #
ISSN-0923-1714 ..... N92-14600 #
ISSN-0923-1714 ..... N92-14618 #
ISSN-0923-1714 ..... N92-14620 #
ISSN-0923-1714 ..... N92-14633 #
ISSN-0923-1714 ..... N92-14634 #
ISSN-0923-1714 ..... N92-14635 #
ISSN-0923-1714 ..... N92-14636 #
ISSN-0923-1714 ..... N92-14637 #
ISSN-0923-1714 ..... N92-14638 #
ISSN-0923-1714 ..... N92-14639 #
ISSN-0923-1714 ..... N92-14640 #
ISSN-0923-1714 ..... N92-14753 #
ISSN-0923-1714 ..... N92-14755 #
ISSN-0923-1714 ..... N92-14756 #
ISSN-0923-1714 ..... N92-14918 #
ISSN-0924-2090 ..... N92-14599 #
ISSN-0924-2090 ..... N92-14738 #
ISSN-0924-2090 ..... N92-14739 #
ISSN-0924-2090 ..... N92-14740 #
ISSN-0924-2090 ..... N92-14768 #
ISSN-0924-3275 ..... N92-14271 #
ISSN-0924-3275 ..... N92-14603* #
ISSN-0924-3275 ..... N92-14651 #
ISSN-0924-3275 ..... N92-14652* #
ISSN-0924-3275 ..... N92-14653 #
ISSN-0924-3275 ..... N92-14654 #
ISSN-0924-3275 ..... N92-14667 #
ISSN-0924-3275 ..... N92-14745 #
ISSN-0924-3275 ..... N92-14746 #
ISSN-0924-3275 ..... N92-14747 #
ISSN-0924-3275 ..... N92-14762 #
ISSN-0924-3275 ..... N92-14769 #
ISSN-0924-3275 ..... N92-14919 #
ISSN-0924-3755 ..... N92-14619 #
ISSN-0924-3755 ..... N92-14665 #
ISSN-0924-3755 ..... N92-14666 #
ISSN-0924-3755 ..... N92-14720 #
ISSN-0924-8374 ..... N92-14621 #
ISSN-0924-8374 ..... N92-14622 #
ISSN-0924-8374 ..... N92-14623 #
ISSN-0924-8374 ..... N92-14721 #
ISSN-0924-8374 ..... N92-14722 #
ISSN-0924-8374 ..... N92-14723 #
ISSN-0924-8374 ..... N92-14754 #
ISSN-0939-2963 ..... N92-14269 #
ISSN-0939-2963 ..... N92-14571 #
ISSN-0939-2963 ..... N92-14959 #

ITEF-113-89 ..... N92-14882 #
ITEF-114-89 ..... N92-14883 #
ITEP-68-89 ..... N92-14881 #
ITEP-120-88 ..... N92-14559 #
ITEP-139-89 ..... N92-14704 #

ITLI-CT-91-05 ..... N92-14621 #
ITLI-CT-91-06 ..... N92-14721 #
ITLI-CT-91-07 ..... N92-14722 #
ITLI-CT-91-08 ..... N92-14622 #
ITLI-CT-91-09 ..... N92-14754 #
ITLI-CT-91-10 ..... N92-14623 #
ITLI-CT-91-11 ..... N92-14723 #

ITLI-ML-90-11 ..... N92-14768 #
ITLI-ML-91-02 ..... N92-14738 #
ITLI-ML-91-03 ..... N92-14739 #
ITLI-ML-91-04 ..... N92-14740 #
ITLI-ML-91-05 ..... N92-14599 #

IWR-91-R-5 ..... N92-14791 #

IYAF-89-164 ..... N92-14858 #
IYAF-90-9 ..... N92-14812 #
IYAF-90-14 ..... N92-14830 #
IYAF-90-15 ..... N92-14705 #
IYAF-90-16 ..... N92-14831 #
IYAF-90-19 ..... N92-14833 #
IYAF-90-20 ..... N92-14857 #
IYAF-90-31 ..... N92-14826 #
IYAF-90-39 ..... N92-14855 #
IYAF-90-40 ..... N92-14856 #
IYAF-90-41 ..... N92-14832 #

JINR-E-2-89-32 ..... N92-14810 #
JINR-E-2-89-333 ..... N92-14811 #
JINR-E-4-89-312 ..... N92-14708 #
JINR-E-5-89-409 ..... N92-14888 #
JINR-E-7-89-88 ..... N92-14942 #
JINR-E-14-89-721 ..... N92-14869 #
JINR-E-17-89-670 ..... N92-14870 #

JINR-R-2-89-5 ..... N92-14260 #
JINR-R-2-89-313 ..... N92-14818 #
JINR-R-2-89-533 ..... N92-14890 #
JINR-R-2-89-566 ..... N92-14889 #
JINR-R-2-89-754 ..... N92-14834 #
JINR-R-4-89-590 ..... N92-14749 #
JINR-R-5-89-402 ..... N92-14887 #
JINR-R-5-89-403 ..... N92-14707 #
JINR-R-14-89-111 ..... N92-14177 #
JINR-R-14-90-297 ..... N92-14146 #

JPL-PUBL-91-18 ..... N92-14771* #

JPL-TDA-PR-42-107 ..... N92-14237* #

JPRS-UES-91-006 ..... N92-14439 #

JPRS-ULS-91-019 ..... N92-14577 #
JPRS-ULS-91-020 ..... N92-14578 #
JPRS-ULS-91-021 ..... N92-14579 #
JPRS-ULS-91-022 ..... N92-14580 #
JPRS-ULS-91-023 ..... N92-14581 #
JPRS-ULS-91-024 ..... N92-14582 #

JPRS-UMS-91-008 ..... N92-14143 #

JPRS-UPM-91-006 ..... N92-14777 #
JPRS-UPM-91-007 ..... N92-14776 #

JPRS-USP-91-006 ..... N92-14068 #
JPRS-USP-91-007 ..... N92-14101 #

KBSL-89-1007 ..... N92-14899 #

KCP-613-4397 ..... N92-14187 #

KFF-FR ..... N92-14374* #

KFTI-89-10 ..... N92-14859 #

KNMI-TR-130 ..... N92-14570
KNMI-TR-131 ..... N92-14575

L-16926-VOL-2 ..... N92-14779* #

LA-UR-91-990 ..... N92-14841 #
LA-UR-91-2900 ..... N92-14339 #
LA-UR-91-2940 ..... N92-14841 #
LA-UR-91-2971 ..... N92-14686 #
LA-UR-91-3012 ..... N92-14826 #
LA-UR-91-3075 ..... N92-14901 #

LA-12129-MS ..... N92-14332 #
LA-12150-MS ..... N92-14821 #

LAMP-90/3 ..... N92-14342 #

LBL-26024 ..... N92-14609 #
LBL-26928 ..... N92-14152 #
LBL-28243 ..... N92-14164 #
LBL-28244 ..... N92-14151 #
LBL-28964 ..... N92-14149 #
LBL-28974 ..... N92-14876 #
LBL-29106 ..... N92-14941 #
LBL-29277 ..... N92-14136 #
LBL-29284 ..... N92-14873 #
LBL-29400 ..... N92-14316 #
LBL-29819 ..... N92-14778 #
LBL-29976 ..... N92-14341 #
LBL-29987 ..... N92-14815 #
LBL-30112 ..... N92-14872 #
LBL-30723 ..... N92-14135 #
LBL-30825 ..... N92-14290 #
LBL-30928 ..... N92-14867 #
LBL-30948 ..... N92-14866 #
LBL-31008 ..... N92-14155 #
LBL-31057 ..... N92-14157 #
LBL-31074 ..... N92-14189 #
LBL-31075 ..... N92-14150 #
LBL-31078 ..... N92-14289 #
LBL-31085 ..... N92-14147 #
LBL-31086 ..... N92-14148 #
LBL-31094 ..... N92-14836 #
LBL-31097 ..... N92-14583 #
LBL-31125 ..... N92-14808 #
LBL-31177 ..... N92-14494 #
LBL-31192 ..... N92-14703 #
LBL-31195 ..... N92-14338 #
LBL-31197 ..... N92-14340 #
LBL-31223 ..... N92-14175 #

LC-91-62173 ..... N92-14236* #
LC-91-62359 ..... N92-14300 #
LC-91-62494 ..... N92-14445 #

LIYAF-1598 ..... N92-14806 #
LIYAF-1602 ..... N92-14173 #
LIYAF-1607 ..... N92-14702 #
LIYAF-1615 ..... N92-14285 #

LPI-TR-91-02 ..... N92-14949* #

LR-623 ..... N92-14325 #
LR-624 ..... N92-14326 #
LR-646 ..... N92-14004 #
LR-650 ..... N92-14798 #
LR-653 ..... N92-14044 #
LR-654 ..... N92-14123 #
LR-655 ..... N92-14045 #

M-676 ..... N92-14108* #

MATHS-REPT-A-135 ..... N92-14605 #
MATHS-REPT-A-144 ..... N92-14605 #

MBB-UD-0593-91-PUB ..... N92-14382 #

MCR-91-1340 ..... N92-14671* #
MCR-91-1341 ..... N92-14672* #

MEMO-INF-91-08 ..... N92-14618 #
MEMO-INF-91-35 ..... N92-14633 #
MEMO-INF-91-40 ..... N92-14755 #
MEMO-INF-91-41 ..... N92-14634 #
MEMO-INF-91-42 ..... N92-14918 #
MEMO-INF-91-43 ..... N92-14619 #
MEMO-INF-91-44 ..... N92-14756 #
MEMO-INF-91-45 ..... N92-14635 #
MEMO-INF-91-46 ..... N92-14636 #
MEMO-INF-91-47 ..... N92-14637 #
MEMO-INF-91-48 ..... N92-14638 #
MEMO-INF-91-49 ..... N92-14600 #
MEMO-INF-91-50 ..... N92-14639 #
MEMO-INF-91-53 ..... N92-14640 #
MEMO-INF-91-54 ..... N92-14753 #
MEMO-INF-91-55 ..... N92-14665 #
MEMO-INF-91-56 ..... N92-14266 #
MEMO-INF-91-58 ..... N92-14666 #
MEMO-INF-91-60 ..... N92-14620 #
MEMO-INF-91-61 ..... N92-14720 #

MEMO-922 ..... N92-14632 #
MEMO-941 ..... N92-14724 #
MEMO-948 ..... N92-14725 #
MEMO-949 ..... N92-14726 #
MEMO-950 ..... N92-14727 #
MEMO-951 ..... N92-14728 #
MEMO-952 ..... N92-14729 #
MEMO-954 ..... N92-14730 #
MEMO-955 ..... N92-14731 #
MEMO-957 ..... N92-14691 #
MEMO-958 ..... N92-14692 #
MEMO-959 ..... N92-14711 #
MEMO-960 ..... N92-14688 #
MEMO-961 ..... N92-14615 #
MEMO-962 ..... N92-14712 #
MEMO-963 ..... N92-14713 #
MEMO-965 ..... N92-14715 #
MEMO-966 ..... N92-14714 #
MEMO-967 ..... N92-14716 #
MEMO-968 ..... N92-14717 #
MEMO-969 ..... N92-14689 #
MEMO-970 ..... N92-14690 #
MEMO-971 ..... N92-14750 #
MEMO-972 ..... N92-14751 #
MEMO-973 ..... N92-14379 #
MEMO-974 ..... N92-14718 #
MEMO-975 ..... N92-14752 #
MEMO-976 ..... N92-14719 #
MEMO-977 ..... N92-14616 #
MEMO-978 ..... N92-14617 #

MIT/LCS/TM-355.B ..... N92-14254 #
MIT/LCS/TM-355.C ..... N92-14254 #

MLM-3705 ..... N92-14396 #

MTL-TR-91-14 ..... N92-14171 #

NAP-S-416 ..... N92-14445 #

NAS 1.15:4323 ..... N92-14956* #
NAS 1.15:100681 ..... N92-14061* #
NAS 1.15:103298 ..... N92-14604* #
NAS 1.15:103555 ..... N92-14958* #
NAS 1.15:103559 ..... N92-14380* #
NAS 1.15:104165 ..... N92-14394* #
NAS 1.15:104187 ..... N92-14790* #
NAS 1.15:104746 ..... N92-14965* #
NAS 1.15:105111 ..... N92-14932*
NAS 1.15:105112 ..... N92-14931*
NAS 1.15:105120 ..... N92-14499* #
NAS 1.15:105143 ..... N92-14109* #
NAS 1.15:105189 ..... N92-14122* #
NAS 1.15:105214 ..... N92-14649* #
NAS 1.15:105233 ..... N92-14120* #
NAS 1.15:105234 ..... N92-14179* #
NAS 1.15:105295 ..... N92-14170* #
NAS 1.15:105307 ..... N92-14294* #
NAS 1.15:105308 ..... N92-14953* #
NAS 1.15:105313 ..... N92-14118* #
NAS 1.15:105321 ..... N92-13998* #
NAS 1.15:105322 ..... N92-14112* #
NAS 1.15:105325 ..... N92-14111* #
NAS 1.15:105333 ..... N92-14485* #
NAS 1.15:105337 ..... N92-14433* #
NAS 1.15:105338 ..... N92-14795* #
NAS 1.15:105347 ..... N92-14063* #
NAS 1.15:105349 ..... N92-14434* #
NAS 1.15:105352 ..... N92-14322* #
NAS 1.15:105363 ..... N92-14114* #
NAS 1.15:105365 ..... N92-14797* #
NAS 1.15:105372 ..... N92-14323* #
NAS 1.15:105384 ..... N92-14000* #
NAS 1.15:105389 ..... N92-14001* #
NAS 1.15:105393 ..... N92-14002* #
NAS 1.15:105453 ..... N92-14898*
NAS 1.15:105455 ..... N92-14104* #
NAS 1.15:105456 ..... N92-14105* #
NAS 1.26:4407 ..... N92-13996* #
NAS 1.26:4413 ..... N92-14041* #
NAS 1.26:4414 ..... N92-13997* #
NAS 1.26:4417 ..... N92-14261* #
NAS 1.26:4420 ..... N92-14598* #
NAS 1.26:177592 ..... N92-14039* #
NAS 1.26:180083 ..... N92-13995* #
NAS 1.26:183487 ..... N92-14490* #
NAS 1.26:183494 ..... N92-14935* #
NAS 1.26:184204 ..... N92-14106* #
NAS 1.26:184247 ..... N92-14595* #
NAS 1.26:184248 ..... N92-14591* #
NAS 1.26:184249 ..... N92-14592* #
NAS 1.26:184250 ..... N92-14593* #
NAS 1.26:184251 ..... N92-14594* #
NAS 1.26:184261 ..... N92-14671* #
NAS 1.26:184262 ..... N92-14672* #
NAS 1.26:184263 ..... N92-14344* #
NAS 1.26:184829 ..... N92-14036* #
NAS 1.26:185272 ..... N92-14110* #
NAS 1.26:185477 ..... N92-14957* #
NAS 1.26:186715 ..... N92-14937* #
NAS 1.26:187315 ..... N92-14894* #
NAS 1.26:187616 ..... N92-14788* #
NAS 1.26:187827 ..... N92-14121* #
NAS 1.26:187902 ..... N92-14943* #
NAS 1.26:188125 ..... N92-13928* #
NAS 1.26:188127 ..... N92-14897* #
NAS 1.26:188128 ..... N92-14572* #
NAS 1.26:188627 ..... N92-14390* #
NAS 1.26:188694 ..... N92-14098* #
NAS 1.26:188718 ..... N92-14611* #
NAS 1.26:188748 ..... N92-14896* #
NAS 1.26:188806 ..... N92-14949* #
NAS 1.26:188812 ..... N92-14955* #
NAS 1.26:188838 ..... N92-14694* #
NAS 1.26:188873 ..... N92-14668* #
NAS 1.26:188929 ..... N92-14391* #
NAS 1.26:188988 ..... N92-14669* #
NAS 1.26:189003 ..... N92-14939* #
NAS 1.26:189018 ..... N92-14038* #
NAS 1.26:189019 ..... N92-14846* #
NAS 1.26:189044 ..... N92-14037* #
NAS 1.26:189053 ..... N92-14374* #
NAS 1.26:189063 ..... N92-14393* #
NAS 1.26:189064 ..... N92-14383* #
NAS 1.26:189067 ..... N92-14392* #
NAS 1.26:189073 ..... N92-14480* #
NAS 1.26:189078 ..... N92-14435* #
NAS 1.26:189090 ..... N92-14436* #
NAS 1.26:189107 ..... N92-14320* #
NAS 1.26:189247 ..... N92-14700* #
NAS 1.26:189251 ..... N92-14330* #
NAS 1.26:189445 ..... N92-14607* #
NAS 1.26:189451 ..... N92-14771* #
NAS 1.26:189461 ..... N92-14789* #
NAS 1.26:189462 ..... N92-14945* #
NAS 1.26:189465 ..... N92-14944* #
NAS 1.26:189467 ..... N92-14313* #
NAS 1.26:189469 ..... N92-14066* #
NAS 1.26:189473 ..... N92-14117* #
NAS 1.26:189474 ..... N92-14555* #
NAS 1.26:189482 ..... N92-14333* #
NAS 1.26:189484 ..... N92-14237* #
NAS 1.26:189495 ..... N92-14314* #
NAS 1.26:189496 ..... N92-14801* #
NAS 1.26:189498 ..... N92-14656* #
NAS 1.26:189509 ..... N92-13999* #
NAS 1.26:189510 ..... N92-14134* #
NAS 1.26:189514 ..... N92-14262* #
NAS 1.26:189515 ..... N92-14263* #
NAS 1.26:189516 ..... N92-14119* #
NAS 1.26:189518 ..... N92-14892* #
NAS 1.26:189521 ..... N92-14586* #
NAS 1.26:189522 ..... N92-14295* #
NAS 1.26:189523 ..... N92-14560* #
NAS 1.26:189524 ..... N92-14186* #
NAS 1.26:189525 ..... N92-14236* #
NAS 1.26:189535 ..... N92-14603* #
NAS 1.26:189542 ..... N92-14652* #
NAS 1.26:189548 ..... N92-14432* #
NAS 1.26:189756 ..... N92-14902* #
NAS 1.55:3122 ..... N92-14346* #
NAS 1.55:3123 ..... N92-14070* #
NAS 1.55:3132 ..... N92-14202* #
NAS 1.60:3181 ..... N92-14108* #
NAS 1.61:1258-VOL-2 ..... N92-14779* #
NAS 1.83:133 ..... N92-14963* #
NAS 1.83:138 ..... N92-14930*

NASA-CP-3122 ..... N92-14346* #
NASA-CP-3123 ..... N92-14070* #
NASA-CP-3132 ..... N92-14202* #

NASA-CR-4407 ..... N92-13996* #
NASA-CR-4413 ..... N92-14041* #
NASA-CR-4414 ..... N92-13997* #
NASA-CR-4417 ..... N92-14261* #
NASA-CR-4420 ..... N92-14598* #
NASA-CR-177592 ..... N92-14039* #
NASA-CR-180083 ..... N92-13995* #
NASA-CR-183487 ..... N92-14490* #
NASA-CR-183494 ..... N92-14935* #
NASA-CR-184204 ..... N92-14106* #
NASA-CR-184247 ..... N92-14595* #
NASA-CR-184248 ..... N92-14591* #
NASA-CR-184249 ..... N92-14592* #
NASA-CR-184250 ..... N92-14593* #
NASA-CR-184251 ..... N92-14594* #
NASA-CR-184261 ..... N92-14671* #
NASA-CR-184262 ..... N92-14672* #
NASA-CR-184263 ..... N92-14344* #
NASA-CR-184829 ..... N92-14036* #
NASA-CR-185272 ..... N92-14110* #
NASA-CR-185477 ..... N92-14957* #
NASA-CR-186715 ..... N92-14937* #
NASA-CR-187315 ..... N92-14894* #
NASA-CR-187616 ..... N92-14788* #
NASA-CR-187827 ..... N92-14121* #
NASA-CR-187902 ..... N92-14943* #
NASA-CR-188125 ..... N92-13928* #
NASA-CR-188127 ..... N92-14897* #
NASA-CR-188128 ..... N92-14572* #
NASA-CR-188627 ..... N92-14390* #
NASA-CR-188694 ..... N92-14098* #
NASA-CR-188718 ..... N92-14611* #

NASA-CR-188748 ..... N92-14896* #
NASA-CR-188806 ..... N92-14949* #
NASA-CR-188812 ..... N92-14955* #
NASA-CR-188838 ..... N92-14694* #
NASA-CR-188873 ..... N92-14668* #
NASA-CR-188929 ..... N92-14391* #
NASA-CR-188988 ..... N92-14669* #
NASA-CR-189003 ..... N92-14939* #
NASA-CR-189018 ..... N92-14038* #
NASA-CR-189019 ..... N92-14846* #
NASA-CR-189044 ..... N92-14037* #
NASA-CR-189053 ..... N92-14374* #
NASA-CR-189063 ..... N92-14393* #
NASA-CR-189064 ..... N92-14383* #
NASA-CR-189067 ..... N92-14392* #
NASA-CR-189073 ..... N92-14480* #
NASA-CR-189078 ..... N92-14435* #
NASA-CR-189090 ..... N92-14436* #
NASA-CR-189107 ..... N92-14320* #
NASA-CR-189247 ..... N92-14700* #
NASA-CR-189251 ..... N92-14330* #
NASA-CR-189445 ..... N92-14607* #
NASA-CR-189451 ..... N92-14771* #
NASA-CR-189461 ..... N92-14789* #
NASA-CR-189462 ..... N92-14945* #
NASA-CR-189465 ..... N92-14944* #
NASA-CR-189467 ..... N92-14313* #
NASA-CR-189469 ..... N92-14066* #
NASA-CR-189473 ..... N92-14117* #
NASA-CR-189474 ..... N92-14555* #
NASA-CR-189482 ..... N92-14333* #
NASA-CR-189484 ..... N92-14237* #
NASA-CR-189495 ..... N92-14314* #
NASA-CR-189496 ..... N92-14801* #
NASA-CR-189498 ..... N92-14656* #
NASA-CR-189509 ..... N92-13999* #
NASA-CR-189510 ..... N92-14134* #
NASA-CR-189514 ..... N92-14262* #
NASA-CR-189515 ..... N92-14263* #
NASA-CR-189516 ..... N92-14119* #
NASA-CR-189518 ..... N92-14892* #
NASA-CR-189521 ..... N92-14586* #
NASA-CR-189522 ..... N92-14295* #
NASA-CR-189523 ..... N92-14560* #
NASA-CR-189524 ..... N92-14186* #
NASA-CR-189525 ..... N92-14236* #
NASA-CR-189535 ..... N92-14603* #
NASA-CR-189542 ..... N92-14652* #
NASA-CR-189548 ..... N92-14432* #
NASA-CR-189756 ..... N92-14902* #

NASA-NP-133 ..... N92-14963* #
NASA-NP-138 ..... N92-14930*

NASA-RP-1258-VOL-2 ..... N92-14779* #

NASA-TM-4323 ..... N92-14956* #
NASA-TM-100881 ..... N92-14061* #
NASA-TM-103298 ..... N92-14604* #
NASA-TM-103555 ..... N92-14958* #
NASA-TM-103559 ..... N92-14380* #
NASA-TM-104165 ..... N92-14394* #
NASA-TM-104187 ..... N92-14790* #
NASA-TM-104746 ..... N92-14965* #
NASA-TM-105111 ..... N92-14932*
NASA-TM-105112 ..... N92-14931*
NASA-TM-105120 ..... N92-14499* #
NASA-TM-105143 ..... N92-14109* #
NASA-TM-105189 ..... N92-14122* #
NASA-TM-105214 ..... N92-14649* #
NASA-TM-105233 ..... N92-14120* #
NASA-TM-105234 ..... N92-14179* #
NASA-TM-105295 ..... N92-14170* #
NASA-TM-105307 ..... N92-14294* #
NASA-TM-105308 ..... N92-14953* #
NASA-TM-105313 ..... N92-14118* #
NASA-TM-105321 ..... N92-13998* #
NASA-TM-105322 ..... N92-14112* #
NASA-TM-105325 ..... N92-14111* #
NASA-TM-105333 ..... N92-14485* #
NASA-TM-105337 ..... N92-14433* #
NASA-TM-105338 ..... N92-14795* #
NASA-TM-105347 ..... N92-14063* #
NASA-TM-105349 ..... N92-14434* #
NASA-TM-105352 ..... N92-14322* #
NASA-TM-105360 ..... N92-14003* #
NASA-TM-105363 ..... N92-14114* #
NASA-TM-105365 ..... N92-14797* #
NASA-TM-105372 ..... N92-14323* #
NASA-TM-105384 ..... N92-14000* #
NASA-TM-105389 ..... N92-14001* #
NASA-TM-105393 ..... N92-14002* #
NASA-TM-105453 ..... N92-14898*
NASA-TM-105455 ..... N92-14104* #
NASA-TM-105456 ..... N92-14105* #

NASA-TP-3181 ..... N92-14108* #

NAVAIR-50-1C-558 ..... N92-14566 #

NIFS-101 ..... N92-14844 #

NIIYAF-MGU-89-8-85 ..... N92-14961 #
NIIYAF-MGU-89-9-86 ..... N92-14962 #
NIIYAF-MGU-89-15-92 ..... N92-14816 #
NIIYAF-MGU-89-32-109 ..... N92-14706 #
NIIYAF-MGU-89-35-112 ..... N92-14952 #
NIIYAF-MGU-89-56-133 ..... N92-14817 #
NIIYAF-MGU-90-2-148 ..... N92-14701 #
NIIYAF-MGU-90-3-149 ..... N92-14960 #
NIIYAF-MGU-90-6-152 ..... N92-14849 #

NIKHEF H/91-07 ..... N92-14824 #

NIKHEF-H/90-22 ..... N92-14822 #
NIKHEF-H/91-06 ..... N92-14823 #

NIST/SP-305-SUPPL-22 ..... N92-14895 #

NLR-TP-90060-L ..... N92-14325 #
NLR-TP-90099-L ..... N92-14326 #

NOAA-DR-ERL-CMDL-8 ..... N92-14564 #

NOAA-TR-NESDIS-57 ..... N92-14565

NPL-DMM(A)-10 ..... N92-14167

NPRDC-TN-91-20-VOL-1 ..... N92-14685 #

NRC-TR-ENG-007 ..... N92-14060 #

NSF-90-132 ..... N92-14602 #
NSF-91-14 ..... N92-14934 #
NSF-91-79 ..... N92-14561 #

NTSB/AAR-91/05 ..... N92-14006 #

NWRA-CR-91-R074 ..... N92-14943* #

ODURF-176615 ..... N92-14333* #

ONERA-NT-1989-5 ..... N92-14168 #

ORNL/CSD/TM-282 ..... N92-14127 #

ORNL/TM-11852 ..... N92-14185 #

OTA-SET-507 ..... N92-14933 #

OTN-021385 ..... N92-14382 #

PB91-165902 ..... N92-14272 #
PB91-179234 ..... N92-13926 #
PB91-202051 ..... N92-13927 #
PB91-205567 ..... N92-14564 #
PB91-216531 ..... N92-14895 #
PB91-910405 ..... N92-14006 #

PINSTECH/NMD-121 ..... N92-14131 #

PINSTECH/NPD-126 ..... N92-14158 #
PINSTECH/NPD-127 ..... N92-14132 #

PL-TN-91-1035 ..... N92-14253 #

PNL-SA-18858 ..... N92-14395 #
PNL-SA-19728 ..... N92-14174 #
PNL-SA-20020 ..... N92-14492 #
PNL-SA-29887 ..... N92-14107 #

PSC-5 ..... N92-14843 #

R/D-4380A-R-AN ..... N92-14181 #

RAE-MAT/STR-312 ..... N92-14166 #

RAE-TM-FS(F)-632-REV-ISSUE-1 ..... N92-14007 #

RAE-TM-P-1205 ..... N92-14319 #

RAE-TM-SPACE-383-PT-1 ..... N92-14099 #

RAE-TR-91025 ..... N92-14166 #

RCC-155-71 ..... N92-14274 #

REPT-90-1 ..... N92-14576 #
REPT-90-80 ..... N92-14601 #
REPT-90-84 ..... N92-14732 #
REPT-90-85 ..... N92-14641 #
REPT-90-86 ..... N92-14642 #

REPT-90-87 ..... N92-14893 #
REPT-90-88 ..... N92-14643 #
REPT-90-89 ..... N92-14644 #
REPT-90-90 ..... N92-14645 #
REPT-90-91 ..... N92-14646 #
REPT-90-92 ..... N92-14647 #
REPT-90-066 ..... N92-14606
REPT-91-1 ..... N92-14097 #
REPT-91-2 ..... N92-14115 #
REPT-91-01 ..... N92-14757 #
REPT-91-12 ..... N92-14321 #
REPT-91-13 ..... N92-14733 #
REPT-91-14 ..... N92-14693 #
REPT-91-15 ..... N92-14648 #
REPT-91-16 ..... N92-14734 #
REPT-91-17 ..... N92-14650 #
REPT-91-19 ..... N92-14437 #
REPT-91-20 ..... N92-14758 #
REPT-91-23 ..... N92-14767 #
REPT-91-30 ..... N92-14324 #
REPT-91-31 ..... N92-14766 #
REPT-91-32 ..... N92-14735 #
REPT-91-34 ..... N92-14736 #
REPT-91-35 ..... N92-14737 #
REPT-91A02175 ..... N92-14956* #
REPT-91B00133 ..... N92-14070* #
REPT-91RC13695 ..... N92-14391* #
REPT-5416-B ..... N92-14006 #
REPT-6670-13 ..... N92-14106* #

RI/RD-91-219 ..... N92-14435* #
RI/RD-91-230 ..... N92-14391* #

RIACS-TR-89-11 ..... N92-14694* #
RIACS-TR-90-37 ..... N92-14668* #
RIACS-TR-90-48 ..... N92-14894* #

RL-TR-91-269 ..... N92-14255 #
RL-TR-91-270 ..... N92-14837 #

RPT/F0094.93A ..... N92-14374* #

RSRE-MEMO-4468 ..... N92-14628 #
RSRE-MEMO-4479 ..... N92-14629 #
RSRE-MEMO-4502 ..... N92-14267 #
RSRE-MEMO-4503 ..... N92-14917 #
RSRE-MEMO-4504 ..... N92-14630 #

RSRE-91014 ..... N92-14624 #
RSRE-91015 ..... N92-14139 #
RSRE-91016 ..... N92-14625 #
RSRE-91019 ..... N92-14626 #
RSRE-91022 ..... N92-14627 #

RUU-CS-91-8 ..... N92-14667 #
RUU-CS-91-9 ..... N92-14769 #
RUU-CS-91-10 ..... N92-14651 #
RUU-CS-91-15 ..... N92-14652* #
RUU-CS-91-16 ..... N92-14603* #
RUU-CS-91-17 ..... N92-14271 #
RUU-CS-91-18 ..... N92-14653 #
RUU-CS-91-22 ..... N92-14745 #
RUU-CS-91-23 ..... N92-14762 #
RUU-CS-91-24 ..... N92-14654 #
RUU-CS-91-25 ..... N92-14746 #
RUU-CS-91-26 ..... N92-14919 #
RUU-CS-91-27 ..... N92-14747 #

R90-916528-80 ..... N92-14037* #

S-HRG-102-113-PT-2 ..... N92-14926 #
S-HRG-102-268 ..... N92-14929 #
S-HRG-102-269 ..... N92-14928 #

S-REPT-102-107 ..... N92-14920 #
S-REPT-102-107 ..... N92-14924 #

S-666 ..... N92-14965* #

SAIC-91/1298:APPAT-144 ..... N92-14957* #

SAND-90-0157C ..... N92-14864 #
SAND-91-0032C ..... N92-14156 #
SAND-91-0130 ..... N92-14288 #
SAND-91-0434C ..... N92-14178 #
SAND-91-0491C ..... N92-14388 #
SAND-91-0876C ..... N92-14104* #
SAND-91-0889C ..... N92-14105* #
SAND-91-1243C ..... N92-14613 #
SAND-91-1374C ..... N92-14377 #
SAND-91-1548 ..... N92-14687 #
SAND-91-1620C ..... N92-14188 #
SAND-91-1824C ..... N92-14863 #
SAND-91-1911C ..... N92-14378 #
SAND-91-1921C ..... N92-14612 #
SAND-91-1922C ..... N92-14159 #

SAND-91-1963C ..... N92-14153 #
SAND-91-1978C ..... N92-14137 #
SAND-91-2013C ..... N92-14293 #
SAND-91-2039C ..... N92-14610 #
SAND-91-2096C ..... N92-14842 #
SAND-91-2229C ..... N92-14165 #
SAND-91-7007 ..... N92-14483 #

SC-MAG-316 ..... N92-14778 #

SCT-91RR-26 ..... N92-14033 #

SC5498-FR ..... N92-14278 #

SDC-91-00081 ..... N92-14800 #

SERI/CP-2360-4494 ..... N92-14482 #

SERI/TP-220-3957 ..... N92-14484 #

SIP-0040 ..... N92-14854 #

SKBS-A1/91-18 ..... N92-14634 #

SRS/STD-TR89-92 ..... N92-14106* #

SRS/STG-TR92-01 ..... N92-14595* #
SRS/STG-TR92-01-VOL-2-APP-A ..... N92-14591* #
SRS/STG-TR92-01-VOL-3 ..... N92-14592* #
SRS/STG-TR92-01-VOL-4-APP-G ..... N92-14593* #
SRS/STG-TR92-01-VOL-5-APP-H ..... N92-14594* #

SSD-TR-90-39 ..... N92-14275 #

SU-SLAC-PUB-5429 ..... N92-14878 #

SU-SLAC/AP-90 ..... N92-14836 #

TACOM-13533 ..... N92-14124 #

TELECOM-PARIS-91-C-002 ..... N92-14584 #

TIOS-91/013 ..... N92-14755 #
TIOS-91/014 ..... N92-14635 #
TIOS-91/015 ..... N92-14636 #
TIOS-91/016 ..... N92-14637 #
TIOS-91/017 ..... N92-14600 #
TIOS-91/018 ..... N92-14638 #
TIOS-91/019 ..... N92-14639 #
TIOS-91/022 ..... N92-14753 #
TIOS-91/023 ..... N92-14266 #
TIOS-91/024 ..... N92-14620 #

TOR-0090(5064)-3 ..... N92-14375 #

TP-499 ..... N92-14788* #
TP-9983 ..... N92-14009

TR-8 ..... N92-14125 #
TR-91-1239 ..... N92-14656* #
TR-111 ..... N92-14282 #
TR-922 ..... N92-14335 #
TR-926 ..... N92-14336 #
TR-0090(5925-08)-2 ..... N92-14275 #

UCB-PTH-91/43 ..... N92-14703 #

UCRL-ID-108066 ..... N92-14264 #

UCRL-JC-106334 ..... N92-14488 #
UCRL-JC-106995 ..... N92-14900 #
UCRL-JC-108141 ..... N92-14557 #

UJV-9170-M ..... N92-14389 #

US-PATENT-APPL-SN-259203 ..... N92-14183
US-PATENT-APPL-SN-460682 ..... N92-14182
US-PATENT-APPL-SN-497464 ..... N92-14281
US-PATENT-APPL-SN-502373 ..... N92-14040
US-PATENT-APPL-SN-509107 ..... N92-14280
US-PATENT-APPL-SN-605623 ..... N92-14279
US-PATENT-APPL-SN-625720 ..... N92-14839 #
US-PATENT-APPL-SN-656330 ..... N92-14376 #
US-PATENT-APPL-SN-678580 ..... N92-14258 #
US-PATENT-APPL-SN-700374 ..... N92-14184 #
US-PATENT-APPL-SN-702570 ..... N92-14062 #
US-PATENT-APPL-SN-708254 ..... N92-14144 #
US-PATENT-APPL-SN-757054 ..... N92-14838 #

US-PATENT-CLASS-89-1.550 ..... N92-14040
US-PATENT-CLASS-102-290 ..... N92-14182
US-PATENT-CLASS-350-9617 ..... N92-14280
US-PATENT-CLASS-367-64 ..... N92-14281
US-PATENT-CLASS-437-41 ..... N92-14279

US-PATENT-5,007,700 ..... N92-14280
US-PATENT-5,011,785 ..... N92-14279
US-PATENT-5,012,121 ..... N92-14281
US-PATENT-5,039,812 ..... N92-14183
US-PATENT-5,042,357 ..... N92-14040
US-PATENT-5,042,385 ..... N92-14182

USAFA-TR-91-12 ..... N92-14069 #

UT-KBS-91-22 ..... N92-14634 #

VKI-TM-47 ..... N92-14329 #

VKI-TN-175 ..... N92-14327 #
VKI-TN-176 ..... N92-14328 #

VTT-120 ..... N92-14190 #

W-9104 ..... N92-14699 #

WHC-EP-0418 ..... N92-14614 #

WHC-SA-1019 ..... N92-14803 #

WL-TR-91-2051 ..... N92-14059 #
WL-TR-91-3078-VOL-3 ..... N92-14386 #
WL-TR-91-8045 ..... N92-14608 #

WRDC-TR-90-3052-VOL-2 ..... N92-14779* #

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